Printed on Thin Paper for Foreign Circulation.

# The Engineer.

Established 1856.

Registered as a Newspaper.

OFFICE FOR ADVERTISEMENTS & PUBLICATION, 28, ESSEX ST., STRAND, LONDON, W.C. 2.

VOL. CLIV.—No. 4008] LONDON: FRIDAY, NOVEMBER 4, 1932 [PRICE ONE SHILLING BY INLAND POST 1s. 3d.

## PUBLIC NOTICES.

### City of Nottingham.

TO BUILDERS AND CONTRACTORS.
MAIN DRAINAGE—CONTRACT No. 10.
SEWAGE PUMPING STATION—SNEINTON.

The General Works and Highways Committee is prepared to receive TENDERS for the ERECTION of a SEWAGE PUMPING STATION off Trent-lane, Sneinton, Nottingham.

Drawings may be seen, and copies of the general conditions of contract, specification, bill of quantities, and form of Tender may be obtained ON AND AFTER THE 7TH INST. on application to Mr. T. Wallis Gordon, City Engineer and Surveyor, Guildhall, Nottingham, on payment of a deposit of £2, which will be returned on receipt of a bona fide Tender.

Sealed Tenders in the official envelope provided are to be delivered to the undersigned not later than 6 p.m. on THURSDAY, 24th NOVEMBER, 1932.

The lowest or any Tender will not necessarily be accepted, and Tenders will only be accepted from contractors who conform with the conditions of contract as regards paying the local standard rate of wages, &c., and to the Working Rules of the Nottingham District.

By Order,
W. J. BOARD,
Town Clerk.

Guildhall, Nottingham,
November 1st, 1932. 9122

### London County Council.

TENDERS are INVITED for FLEET STORM RELIEF SEWER, Pentonville-road Branch Extension. The work to be executed comprises the Construction in Tunnel of a 6ft. internal diameter Brick Sewer of a length of about 1510ft., and a Weir Chamber Connection in Caledonian-road, all in the Borough of Islington, in the Administrative County of London.

Specification, form of Tender, &c., may be obtained on application to the Chief Engineer upon payment of £5 by crossed cheque or order payable to the London County Council. (NOTE.—CASH WILL NOT BE ACCEPTED.) This amount will be returnable only if a bona fide Tender has been sent in and not subsequently withdrawn. Full particulars of the work may be obtained on personal application and the contract documents may be inspected before payment of the fee.

Remittances by post should be addressed to the CHIEF ENGINEER (A), The Old County Hall, Spring-gardens, S.W.1. Personal inquiries at Room 2, No. 8, Warwick House-street, Cockspur-street, S.W.1.

The contractor will be bound to observe the provisions of a fair wages clause, the terms of which are set out fully in the instructions for Tender and form of contract and in the "London County Council Gazette."

No Tender received by the Clerk of the Council at the County Hall, Westminster Bridge, S.E.1, after 4 p.m. on Monday, 5th December, 1932, will be considered.

The Council does not bind itself to accept the LOWEST or any Tender. 9116

### County Borough of Brighton.

WATERWORKS DEPARTMENT.
APPOINTMENT OF SECOND ENGINEERING ASSISTANT.

APPLICATIONS are INVITED for the APPOINTMENT of SECOND ENGINEERING ASSISTANT in the above Department, at a commencing salary of Five Pounds per week (less temporary deduction of 2s. 1d.).

Candidates, whose age should not exceed 35 years, must be well educated and have had previous experience in a Waterworks Engineer's office. They should be good Surveyors and Levellers, neat and expeditious Draughtsmen, and possess a sound knowledge of Building Construction, Service Reservoir Design, and Pipework. Other things being equal, preference will be given to candidates who have passed Sections A and B of the Associate Membership Examinations of the Institution of Civil Engineers.

Applications, stating age, qualifications and experience, accompanied by copies of not more than three recent testimonials, and endorsed "Second Engineering Assistant," should be addressed to me and delivered at my office not later than Wednesday, the 16th November, 1932.

A. B. CATHCART,
Waterworks Engineer.

12, Bond-street,
Brighton,
4th November, 1932 9121

### County Borough of Southampton.

APPOINTMENT OF A SUPERINTENDENT IN THE WATERWORKS DEPARTMENT.

The Corporation invite APPLICATIONS for the POSITION of SUPERINTENDENT in their Waterworks Department.

Applicants should have a thorough knowledge of water fittings, water meters, plumbing, the laying and repairing of water mains and the maintenance of motor vehicles, and should not be more than 40 years of age. Experience in the duties of Superintendent in other waterworks undertakings will be advantageous.

The person appointed will be required to organise the labour and transport of the Department, other than that employed at the Pumping Stations, to supervise the system of inspection and waste detection within the whole of the Corporation's area of supply, and to carry out such other duties as may from time to time be allotted to him. He will hold office during the pleasure of the Council. His salary will be £350 per annum, subject to a temporary abatement (at present £5 per annum). A motor car allowance of £125 per annum will also be paid. He will be required to live within two minutes' walk of the Waterworks Depot, in Shirley-road, where accommodation for a motor car will be provided.

The Local Government and Other Officers' Superannuation Act, 1922, will be applicable to the appointment and contributions to the Superannuation Fund will be deducted from the salary. The selected candidate will be required to pass a satisfactory medical examination.

Applications, stating previous and present appointments, experience, date on which appointment could be taken up, and any other relevant particulars, and accompanied by copies of not more than three recent testimonials, must be enclosed in sealed envelopes and endorsed "Appointment of Superintendent," and addressed to the Town Clerk, Municipal Offices, Southampton, and delivered there on or before 19th November, 1932.

Canvassing is prohibited and will disqualify.

R. RONALD H. MEGGESON,
Town Clerk.

22nd October, 1932. 9089

### Swanage Urban District Council.

A CLERK OF WORKS is REQUIRED by the above Council in connection with the Erection of Four Timber Groynes on the Beach. Salary £5 5s. 0d. per week. Applications from persons experienced in this class of work, giving full particulars of their experience, and stating age, should be forwarded, with copies of two recent testimonials, to the undersigned by not later than Saturday, 19th November.

THOS. ARNOLD,
Clerk to the Council.

Town Hall, Swanage,
1st November, 1932. 9123

## The Engineer

### PRINCIPAL CONTENTS OF THIS ISSUE.

ARRANGED FOR CARD INDEXING.

The French Liner Normandie. (P. 463)
THE ENGINEER, 4 - 11 - 32.

Mechanical Engineering Applied to the Making of Lenses. (P. 450)
(W. TAYLOR.) THE ENGINEER, 4 - 11 - 32.

Precision Grinding Machines No. VII. (P. 449)
THE ENGINEER, 4 - 11 - 32.

Egypt and the Sudan. (P. 460)
(SIR M. MACDONALD.) THE ENGINEER, 4 - 11 - 32.

The Surbiton Waterworks—No. II. (P. 452)
THE ENGINEER, 4 - 11 - 32.

The Work of Andrew Laing. (P. 465)
(SIR R. W. SKELTON.) THE ENGINEER, 4 - 11 - 32.

International Association for Testing Materials. (P. 464)
THE ENGINEER, 4 - 11 - 32.

More Majorum. (P. 459)
THE ENGINEER, 4 - 11 - 32.

## INDEX TO ADVERTISEMENTS, PAGE 69.

## PUBLIC NOTICES.

### Armourers' and Brasiers' Company IN THE CITY OF LONDON.

LECTURES IN METALLURGY.

The Company have arranged for a COURSE of THREE LECTURES to be delivered at the ROYAL SCHOOL of MINES, Prince Consort-road, South Kensington, at 5.30 p.m. on TUESDAYS, the 15th, 22nd, and 29th NOVEMBER, 1932, by Professor Sir HAROLD CARPENTER, F.R.S., M.A., Ph.D., on

"THE METALLOGRAPHY OF SOME NATIVE METALS."

Admission Free, without Ticket. 9099

## SITUATIONS OPEN.

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

TO ADVERTISERS UNDER BOX NUMBERS IN THIS CLASSIFICATION.

For the benefit of applicants, the Proprietors are prepared to insert brief notices that vacancies are filled, upon receipt of notifications from the Advertisers. These notices (limited to one line) will be free of charge and co-operation is asked for.

ELECTRIC HEATERS AND COOKERS.—PRODUCTION ENGINEER REQUIRED for Birmingham district to take entire charge of manufacture. Must be a good organiser and have had previous experience of Repetitive Assembly. Applications, which will be treated in confidence, must state full qualifications, past experience, and salary required.—Write Box Y199, Willings, 86, Strand, W.C.2. 9120 A

ENGINEER WORKS MANAGER REQUIRED in London district to Control Design and Production of Jigs and Tools, Manufacture and Assembly of Small Precision Electrical Machines, and all the necessary services. Machine and Press Shop and Production Control experience is essential.—Address, giving precise details of qualifications, age, and salary, P2943, The Engineer Office. P2943 A

## SITUATIONS OPEN (continued).

OLD-ESTABLISHED COMPANY, Dealing in Non-ferrous alloys and white anti-friction metals in all forms, REQUIRES smart energetic REPRESENTATIVE, young, with engineering knowledge.—Write, stating details of experience, age, salary, &c., to "R. O.," c/o J. W. Vickers and Co., Ltd., 24, Austin Friars, E.C.2. P2934 A

REQUIRED IMMEDIATELY by an Important Iron and Steel Company, a SALES ENGINEER, age about 30 to 35 years, whose headquarters will be London. Must have had practical experience in the Production of Steel Sheets from the Open Hearth to the Finished Product. All applications will be treated in strict confidence, and applicants must give full details of their career and salary required.

Address, 9125, The Engineer Office. 9125 A

TOOL DESIGNER WANTED.—A Well-known FIRM manufacturing Radio Components REQUIRE the SERVICES of an Expert TOOL DESIGNER who can take complete charge of the Machine Shop.—Write, stating experience, age and salary required to: Box 350, National Publicity Co., 43, Shoe-lane, E.C.4. 9126 A

WORKS SUPERINTENDENT REQUIRED. Must be fully qualified engineer with experience in Iron and Brass Foundry Practice, Machine Shop and General Engineering, Rate Fixing and Control of Labour.—Address, stating age, education, qualifications and salary required, with references, 9127, The Engineer Office. 9127 A

WANTED, First-class MECHANICAL ENGINEER DRAUGHTSMAN, skilled in the design of Heavy Power-driven Chemical Plant with precision engine finish. Quick in preparing working detail drawings from sketches and complete specifications.—Address, stating age, experience, &c., to "Ref. 6," 9081, The Engineer Office. 9081 A

FIRST-CLASS DRAUGHTSMAN REQUIRED, East London Area, with qualifications in Boilerwork, Pressure Vessels, Chemical Plant. State age, experience, salary required.—Address, 9128, The Engineer Office. 9128 A

JUNIOR DRAUGHTSMAN, Age Not Exceeding 25, with workshop and technical class training, REQUIRED in London area for General Engineering Drawing. Pay £2 1s. 2d. for a 42-hour week.—Write, J. N., c/o Charles Barker and Sons, Ltd., 31, Budge-row, E.C.4. 9115 A

## SITUATIONS WANTED.

A WORKS MANAGER, PRODUCTION or PLANNING ENGINEER, wide experience of machine tools and engine work; capable organiser, excellent references. Last appointment reduced cost of production by over 55 per cent. Very moderate salary. Small or medium size works preferred.—Address, P2947, The Engineer Office. P2947 B

A FULLY QUALIFIED ENGINEER and DESIGNER of proved inventive ability SEEKS ENGAGEMENT. Efficient draughtsman; first-class varied experience. Used to acting on own initiative. Competent to carry to successful conclusion new schemes, &c. Fluent French, highest references; small salary.—Address, L. B., 4, Madeley-road, Ealing, W.5. P2893 B

A.M.I.C.E., B.Sc., Commercial and Technical Engineering MANAGER, age 33, having specialised knowledge and many years' experience of oil engines, all types of pumping installations, electrical generating plant and refrigeration, REQUIRES POSITION next January as Engineering Manager of Waterworks or Industrial Undertaking.—Address, P2933, The Engineer Office. P2933 B

B.SC. (25), London University, Public School, and Clyde apprenticeship in steam, SEEKS APPOINTMENT, preferably in South. Accept small salary for good prospects.—Address, P2948, The Engineer Office. P2948 B

ENGINEER (28), Single, with Secondary and Technical College education and nine years' general machine shop practice, DESIRES POST with opportunities for administrative experience. Keen and energetic. London or South-East preferred.—Address, P2938, The Engineer Office. P2938 B

ENGINEER (33) SEEKS POSITION: Experienced works design, erection, maintenance; good organiser and disciplinarian.—BM/LO 24, London, W.C.1. P2894 B

METALLURGIST, Non-ferrous, Highly Qualified, extensive works' and laby. experience, now holding responsible posn., SEEKS CHANGE. Technical and coll. German, good knowledge French and Russian.—Address, P2877, The Engineer Office. P2877 B

QUALIFIED ENGINEER, B.Sc. (Lond.), 8 Years' experience, specialised in colliery electrical plant, large winders, pumping and ventilating installations, &c., also experience of generating stations and transmission work, DESIRES RESPONSIBLE POSITION.—Address, P2932, The Engineer Office. P2932 B

SALES ENGINEER and REPRESENTATIVE (30), at present with London engineers and contractors, DESIRES CHANGE.—CATCHPOLE, 15, St. Margaret's-avenue, Harringay. P2944 B

STRUCT. ENGINEER (25), Sound Tech. Qualifications, 10 yrs.' D.O., DESIRES PROGRESSIVE SITU., home or abroad.—Address, P2940, The Engineer Office. P2940 B

TO CONSTRUCTIONAL AND GENERAL ENGINEERING FIRMS.—A well-known, successful CHIEF SALES REPRESENTATIVE PREPARED to SELL HIMSELF. Payment on results.—Address, P2912, The Engineer Office. P2912 B

YOUNG ENGLISHMAN SEEKS SECRETARIAL POSITION in Engineering Industry. Any part. Highly qualified shorthand-typist; speeds 170 and 60. Certificate in written and spoken English (Lond.). Translates from French and German; visited Continent. Semi-technical experience; good references; moderate salary.—Address, P2936, The Engineer Office. P2936 B

DRAUGHTSMAN, Civil Engineering and Oil storage, 12 years' experience; ex. refs.; Age 29.—Address, P2939, The Engineer Office. P2939 B

ENGINEER DRAUGHTSMAN, Works and University training, 16 yrs' D.O. and technical assistant, adaptable, plenty of initiative, all-round knowledge, good organiser and designer.—Address, P2941, The Engineer Office. P2941 B

OIL REFINERY DRAUGHTSMAN (37), 42 Yrs.' D.O. experience in modern refinery, storage, buildings, plant lay-out; Nat. Cert. (ord.), 4 yrs. workshop student, 3 yrs. D.O. improver; mod. salary, home or abroad. Holds position at present.—Address, P2937, The Engineer Office. P2937 B

FOREMAN, 15 Years General Engineering, any branch, SEEKS POST; disengaged, excellent references.—TURNER, 9, Langdale-road, Thornton Heath. P2942 B

PATTERNMAKER, Age 35, Excellent Experience all classes engineering work; quick and accurate worker.—Address, P2945, The Engineer Office. P2945 B

## PARTNERSHIPS.

DIRECTOR REQUIRED for New Small Machinery company, to take Management of Works in London district.—'Phone for appointment Museum 8777, or write "MACHINERY," 48, Great Russell-street, W.C.1. P2949 C

AUCTIONS, Page 70.
AGENCIES, Page 2.
MISCELLANEOUS, Page 2.
MACHINERY, &c., WANTED, Page 70.
FOR SALE, Pages 2 and 70.
EDUCATIONAL, Page 2.
PATENTS, Page 70.
BUSINESSES and PREMISES (For Sale, &c.), Page 70.
WORK WANTED, Page 70.

*For Advertisement Rates see First Column Overleaf.*

## The Engineer

### Annual Subscription Rates

(including postal charges).

Le prix de l'abonnement est accepté en livres sterling, ou dans la monnaie du pays d'origine au cours du change au moment de la commande.

Die Bezugsgebühren sind zahlbar in Pfundsterling oder in der Landeswährung des Bestellers, umgerechnet zum Kurse des Tages an dem die Bezahlung erfolgt.

Serán aceptados los abonos en moneda esterlina o su equivalente calculado en la moneda del páis de origen al cambio efectivo a la fecha de ponérse el pedido.

| | | | | |
|---|---|---|---|---|
| BRITISH ISLES .. | £3 | 5 | 0 | |
| CANADA .. .. .. | £3 | 3 | 0 | Thick Paper Ed. |
| | £2 | 18 | 6 | Thin Paper Ed. |
| ABROAD .. .. | £3 | 7 | 6 | Thick Paper Ed. |
| (except Canada) | £3 | 3 | 0 | Thin Paper Ed. |

AFRICA .. .. Central News Agency. All Branches.
CAPE TOWN: Wm. Dawson and Sons, Ltd., 29–31, Long-street (Box 489)
JOHANNESBURG: C. Juta and Co.

ARGENTINE .. BUENOS AIRES: Mitchell's Book Store, 576, Cangallo

AUSTRALIA .. Gordon and Gotch (Australasia), Ltd. All Branches
MELBOURNE: Robertson and Mullens, Elizabeth-street

BELGIUM .. BRUXELLES: E. Graddon, 186A Avenue Rogier, Schaerbeek
BRUXELLES: W. H. Smith and Son, 78–80, Rue du Marché-aux-Herbes

CANADA .. .. American News Company, Ltd. All Branches
MONTREAL: Gordon and Gotch, Ltd., 334, Notre Dame-street, W.
TORONTO: Wm. Dawson Subscription Service, Ltd., 70, King-street East
TORONTO: Gordon and Gotch, Ltd., 81, Queen-street West

CEYLON .. .. COLOMBO: Wijayartna and Co.

CHINA .. .. HONG KONG: Kelly and Walsh, Ltd.
SHANGHAI: Kelly and Walsh, Ltd.

DENMARK .. Teknisk Presse Bureau, Ourøgade 34, Copenhagen

EGYPT .. .. CAIRO: Express Book and Stationery Store, 9, Chareh Maghrabi

FINLAND .. HELSINGFORS: Akademiska Bokhandeln, Alexandersgatan, 7

FRANCE .. .. PARIS: Boyveau and Chevillet, Rue de la Banque, 22
PARIS: Librarie Berger-Levrault, 229, Bld. St. Germain
PARIS: Brentano's, 37, Av. de l'Opera
PARIS: Dunod, 92, Rue Bonaparte
PARIS: W. H. Smith and Son, 248, Rue de Rivoli

GERMANY .. BERLIN - LICHTERFELDE - WEST: H. Hermanns, Dahlemer Strasse, 64 A
LEIPZIG: K. W. Hiersemann, Konigstrasse 29

HOLLAND .. ROTTERDAM: Hector's Boekhandel, Noordblaak 59
ROTTERDAM: Techn. Boekhandel, "Plan C," Gelderschestraat 4

INDIA .. .. BOMBAY: Thacker and Co., Ltd.
CALCUTTA: Thacker, Spink and Co.

ITALY .. .. MILAN: Ulrico Hoepli
ROME: Maglioni and Strini, 307, Corso
ROME: Fratelli Treves, Corso Umberto 1, 174
ROME: Fratelli Bocca
TURIN: Rosenberg and Seiller, v. Maria Vittoria 18, and their Branches at Naples and Rome

JAPAN .. .. Maruzen Co. All Branches

JAMAICA .. .. KINGSTON: Educational Supply Co.

NEW ZEALAND AUCKLAND: Whitcombe and Tombs, Ltd.
Gordon & Gotch, Ltd. All Branches
NAPIER: J. Wilson Craig and Co.

RUSSIA .. .. LENINGRAD: Meshdunarodnaja Kniga, Prospect Volodarsky, 53A
MOSCOW: Kuznetski Most 18.

STRAITS SETTLEMENTS—SINGAPORE: Kelly and Walsh, Ltd.

SWEDEN .. .. STOCKHOLM: A/B Wennergrens Journal-expedition, Stockholm 1
STOCKHOLM: A/B C. E. Fritzes Kungl., Hofbokhandel, Fredsgatan, 2

SWITZERLAND ZURICH: Rosa Leibowics, 4, Ankerstr.

UNITED STATES OF AMERICA International News Co., 131, Varick-street, New York, N.Y., and all Branches

Entered as second-class matter at the Post Office, New York, N.Y., December 12th, 1896, under the Act of March 3rd, 1879 (Section 397, P.L. & R.).

*.* READING CASES, *to hold two copies of* THE ENGINEER, *cloth sides and leather backs, can now be supplied at 4s. 9d. each, 5s. 3d. post free.*


### "THE METALLURGIST."

This Supplement, which deals with the Science and Practice of Metallurgy, both ferrous and non-ferrous, is published free with the last issue of THE ENGINEER in each calendar month.

### ADVERTISEMENTS.

**The charge for Classified Advertisements is 1/- per line up to one inch—minimum charge 4/-; those occupying one inch or more at the rate of 12/- per inch. Orders must be accompanied by a remittance. The rates for Displayed Advertisements will be forwarded on application. Classified Advertisements cannot be inserted unless delivered before TWO o'clock on Wednesday afternoon.**

*Letters relating to the Advertisement and the Publishing Department of the Paper are to be addressed to the Publisher, all other letters are to be addressed to the Editor of* THE ENGINEER.

### THE ENGINEER DIRECTORY.

This Directory, which is published annually in the interests of advertisers in THE ENGINEER, may be obtained free of charge on application to the Publisher.


Postal Address, 28, Essex-street, Strand, London. W.C. 2.
Teleg. Address, "Engineer Newspaper, Estrand, London." Tel., Central 6565 (3 lines).



PUBLISHED BY PITMAN'S

**THE ELEMENTS OF SWITCHGEAR DESIGN**

By ING. FRITZ KESSELRING.

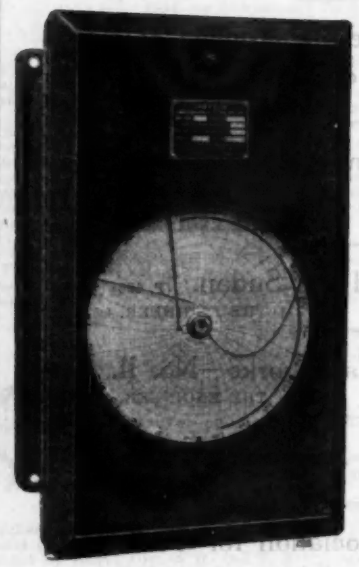
Translated from the German by S. R. MELLONIE, A.M.I.E.E., Assoc. A.I.E.E., and J. SOLOMON, B.Sc., A.M.I.E.E.

A study of the theoretical principles underlying modern practice in the construction and design of switchgear apparatus. It provides a solid and reliable background of essential knowledge for students and a useful reference for engineers concerned with the manufacture and applications of switchgear. Incidental formulæ are clearly worked out and explained. With 80 diagrams. 190 pp. **7s. 6d. net.**

*Write for detailed prospectus, post free on request.*

**SIR ISAAC PITMAN & SONS, LTD., PARKER ST., KINGSWAY, LONDON, W.C. 2**

**DRAYTON**
**RING BALANCE**
**RECORDERS.**



Drayton Ring Balance Pressure Recorder with circular chart.

Ring Balance Recorders for simple or differential pressure, vacuum, flow and volume are supplied with tape chart or with circular chart as shown. They are available with large scale indicator and/or with integrator of simple and thoroughly satisfactory design. The Drayton Ring Balance instrument is carefully constructed to give accurate and reliable readings and every detail of design has been studied to this end. The mechanism is housed in a neat dignified case, which is sufficiently robust for all practical purposes and is dirt and splash tight.

Instruments combined with automatic regulator feature can be supplied, the Drayton Ring Balance Ratio Volume Regulator being an advanced example of this application.

***May we send you list No. 164 38.***

**THE DRAYTON REGULATOR AND INSTRUMENT CO., LTD.**

**WEST DRAYTON, MIDDLESEX.**

2124

**EDUCATIONAL.**

CORRESPONDENCE COURSES of Preparation for the EXAMINATIONS of the INST. OF CIVIL ENGINEERS, INST. OF MECHANICAL ENGRS., PRELIMINARIES, MATRICULATION, &c., ARE PERSONALLY CONDUCTED BY

Mr. TREVOR W. PHILLIPS.

B.Sc. (Honours), Assoc. M. Inst. C.E., A.M.I.Struct.E., M.R.S.I., F.R.S.A., Chartered Civil Engineer, &c.

*Prospectus and full particulars on application to:*—
26, DALE STREET, LIVERPOOL.
LONDON OFFICE:—65, CHANCERY LANE, W.C.2.

**A.M. Inst. C.E. EXAM., MAY, 1932.**

**FIRST PLACE.**

**Gained by T. I. G. B. Student.**

***Read his letter, which speaks for itself:—***

"You will be pleased to hear that, at the recent examinations of The Institution of Civil Engineers, I obtained highest place in the Associate Membership Examination, Sections A and B, and have been awarded the "Bayliss Prize" of £15. I am, of course, extremely gratified by this result and hasten to thank you for your valuable help and guidance during my studies for this examination. I hope that my success will be crowned by receiving Associate Membership of your Institution, which has been of real service to me."

F.G.T. (Studentship No. 17472.)

*The services of over 70 specialists, many of whom are recognised authorities in their respective spheres, have been utilised in the compilation of The T.I.G.B.'s Correspondence Courses. Write to-day for "The Engineer's Guide to Success"—140 pages—containing the widest selection of engineering courses in the world. The T.I.G.B. guarantees training until successful.*

**The Technological Institute of Great Britain,**
**76, Temple Bar House, London, E.C. 4.**
(*Founded* 1917. 18,000 *Successes*)

**MISCELLANEOUS.**

DISTINCTIVE LETTER HEADINGS DESIGNED for £2 2s. Blocks prepared and plates engraved.—Address, P2919, The Engineer Office. P2919 I

**IMPORTANT NOTICE.**

After months of intensive effort and research we are pleased to announce that our new Hand-Book is now out of the publisher's hands and ready for distribution. Containing 250 pages of practical guidance, this book is beyond argument the finest and most complete Hand-Book on Successful Engineering Careers ever compiled. It is a book that should be on the bookshelf of every Engineer, whatever his age, position or experience. The book contains, amongst other intensely interesting matter, details of B.Sc., A.M.I.C.E., A.M.I. Mech. E., I.E.E., A.M.I.A.E., F.S.I., G.P.O. and every other important Engineering Examination; outlines Courses in all branches of Civil, Mech., Elec., Motor, Radio, Aero., and "Talkie" Eng., and explains the unique methods of our Appointments Department. We alone guarantee "NO PASS—NO FEE." The new "ENGINEERING OPPORTUNITIES" is bound to create a mild furore in engineering circles. See that you get your copy by writing to-day—FREE and post free.

**British Institute of Engineering Technology,**
**22, Shakespeare House, 29-31, Oxford Street, W.1.**
9117 I

**AGENCIES.**

AGENCY is REQUIRED by MAYER BROS. TRADING CO., P.O. Box 2160, Johannesburg, S. Africa, holding excellent connection in steel, galv. iron, incandescent lamps, paints, &c. Only well-known firms of good repute considered. P2935 D

ENGINEER REPRESENTATIVES Having Well-established connections with Hydraulic Machinery users and free to Introduce New Article on liberal commission terms, please communicate with P2946, The Engineer Office. P2946 D

OLD-ESTABLISHED BRITISH HOUSE, Replacing important German Works' and other Agencies, DESIRE REPRESENT in Lancashire, Yorkshire and Cheshire, commission basis, leading British Works with large outputs—Semis and Finished Steel, Heavy Steel Castings, and Forgings of largest dimensions.—Address, 9129, The Engineer Office. 9129 D

QUALIFIED ENGINEER, Excellent Connection public supply undertakings, contractors and consulting engineers, WISHES REPRESENT for London and South of England first-class ENGINEERING CONCERN.—Address, P2950, The Engineer Office. P2950 D

**FOR SALE.**

AIR COMPRESSORS (Belt-driven).
254 cu. ft. Ingersoll-Rand, E.E.I. Type; £90.
396 cu. ft. Ingersoll-Rand, E.R.I. Type; £120.
400 cu. ft. Tilghman, as new; £120.
274 cu. ft. Keavell, latest type; £90.
550 cu. ft. Consolidated, Type N.S.B.; £160.
ALL ABOVE FOR 100 LB. WORKING PRESSURE.
500 cu. ft. Steam-driven Sentinel Compressor; Cheap.
OIL ENGINE AND ALTERNATOR.
120 B.E.P. Paxman Cold-starting Crude Oil Engine, coupled direct on base-plate to 75-kW Alternator, by B.E.P. Co., Alloa, complete with Exciter and all necessary Gear, Switchboard, Starting Set, &c.
ABOVE IS AS NEW—ONLY USED A YEAR.
Will be sold CHEAPLY to save removal (lying London).
ALEX. HAMMOND, Boxted, Slough. 9114 G

**BOILERS, TANKS and AIR RECEIVERS.**

New, several 11ft. long by 5ft., Reg. 80 lb. W.P.
Lancashire Boiler, 30ft. by 7ft., 80 lb. W.P.
Cornish Boiler (1915), 24ft. by 6ft. 6in., 80 lb. W.P.
TANKS (Boiler Shells), 20ft. by 8ft., extra heavy.
Ditto 20ft. by 7ft.
**H. & T. DANKS (Netherton), LTD.**
Boilermakers and Engineers, Netherton, DUDLEY.
5540 G

FOR SALE, ONE B.T.H. 50 H.P., 725 r.p.m., Slip-ring INDUCTION MOTOR, for use on 3-phase, 400 volts, 50 cycles circuits. Also ONE B.T.H. STARTER for above. All new, never been run. Price complete £85; 270 Yards of CABLE for same, £18 extra.—GEORGE WILKINSON (BURNLEY), Ltd., "Progress" Works, Burnley. 9118 G

FOR SALE, THEODOLITES, DRAWING INSTRUMENTS, SECOND-HAND. CLARKSON'S, 338, High Holborn, W.C. (Opposite Gray's Inn-road).

FOR SALE, LEVELS, DRAWING INSTRUMENTS, SECOND-HAND. CLARKSON'S, 338, High Holborn, W.C. (Opposite Gray's Inn-road). EX.

FOR SALE.
THREE 30ft. by 9ft CYLINDRICAL PETROL STORAGE TANKS.
10in. by 12in. VERTICAL THREE-THROW BELT-DRIVEN RAM PUMP, by Pearns, capacity 23,000 gallons per hour.
VERTICAL COMPOUND BOILER FEED PUMP, by Hall and Sons, 6½in. and 9½in. cylinders by 6½in. water end by 12in. stroke.
STANLEY ENGINEERING CO., Bath. Telephone 4394.

HESSIAN, PACKING CANVAS, SACKING, SACKS, FIBRES. Any quantity supplied.—H. C. JOHNSON and CO., 58, Kinfauns-road, Goodmayes, Essex. P2909 G

IMPREGNATING and DRYING CHAMBER for Armatures, &c., by Geo. Scott, practically new; chamber 15ft. long by 7ft. 6in. dia., with Condenser, Vacuum Pump and Compressor, Mixing Tank with about 700 gals. Insulating Varnish. Bargain price.
HARRY H. GARDAM and CO., Ltd., Staines. 9131 G

JOHN HANDS' WORKS, BIRMINGHAM.

**MACHINERY AND PLANT FOR SALE**

Twenty Gap Bed and other LATHES. Well-known makers.
Seven Horizontal and Vertical BORING MACHINES. Dickinson, Bullard, etc.
Five RADIAL DRILLING MACHINES up to 6ft., by Swift, Archdale, Cincinatti-Bickford.
Butler PLANER, 14ft. by 6ft. by 6ft.
Herbert PLANER, 12ft. by 5ft. by 5ft.
Four SHAPING MACHINES, 15in. by 24in. stroke. Steptoe, Butler, Dickinson, etc.
SLOTTING MACHINES, HACK SAWS, MILLING MACHINES, POWER PRESSES, HYDRAULIC PLANT.
*Write for detailed catalogue:*
**JOHN HANDS' CARDIGAN WORKS,**
BELMONT ROW, BIRMINGHAM.

'PHONE 98 STAINES.
50 H.P. Petter CRUDE OIL ENGINE, Electric Lighting Type. Bargain.
12 N.H.P. Marshall LOCO. BOILER, 120 lb. W.P.
150-kW Allen STEAM GENERATING SET, 230/250 vo. D.C.
150-kW Browett-Siemens DITTO, 460/500 vo. D.C.
Weir FEED PUMPS, 10,000, 5000, 3000, 1500 g.p.h.
350 H.P. English Electric MOTOR, 220 vo. D.C., 600 revs., 3 bearings.
160-kW DYNAMO, by Allen, 220 volts D.C., 375/400 revs.
HARRY H. GARDAM and CO., Limited, Staines. 9090 G

**600**

Modern HEAVY OIL ENGINE, 400 B.H.P. Horizontal 4-Cylinder Engine by Campbell; cold starting; speed 210 r.p.m. Solid Injection Automatic Lubrication. New 1928.

Two 300 B.H.P. Vertical Semi-Diesel CRUDE OIL ENGINES by Vickers/Petter; 4 Cylinders; compressed air starting; speed 250 r.p.m., with rope driving pulley and accessories.

Other sizes in stock down to 5 B.H.P.

Quotations submitted for complete installations. Full details upon request.

**GEORGE COHEN SONS**
AND CO., LTD.,
600, COMMERCIAL ROAD EAST, LONDON, E. 14.
*Telephone: East 6060. Telegrams: "Coborn," London.*


**For continuation of For Sale Advertisements see page 70.**


**Spencer-Bonecourt Patent Waste Heat Boilers.**
32, Farringdon Street, E.C. 4.

# A Seven-Day Journal

## Old Cromptonians Dinner.

NEARLY a hundred guests sat down to the annual dinner of the Old Cromptonians, which was held on Friday, October 28th, at the Hotel Victoria. Among the company there were several members who had been pupils at the old Arc Works before 1885, and over twenty whose associations with the company dated back about forty years. Colonel Crompton, who presided, was in remarkably good health and spirits, and it is difficult to believe that he is in his eighty-eighth year. He recalled that he turned his attention to electrical engineering when his proposals for commercial mechanical road transport were derided and ridiculed, so that the industry gained him at the expense of another. In replying to the toast of "The Company," Mr. Frank Parkinson said he felt that the human side of the industry was becoming of more importance every year, and that he would like to see more of the younger Cromptonians (among whom he numbered himself) as members of the Association. He referred to his efforts for the formation of a great British company, making a complete range of electrical products, entirely free from foreign influence, or the domination of foreign capital. That ambition had been partially realised by the recent association of the company with the British Electric Transformer Company, Ltd., and Derby Cables, Ltd.

## Canadian Railway Reform.

IN the Canadian Senate, on October 28th, Mr. Meighen, leader of the Government, introduced a Bill to implement the recommendations of the Royal Commission on Transportation, which were discussed, it may be recalled, in a leading article in our issue of September 30th. He described the Bill as a complete statutory embodiment of the report of the Commission, except for a minor clause. The first part of the Bill provides for the abolishment of the present directorate of the Canadian National Railways and the appointment of three trustees, with power to act independently of the Government, Parliament, and security holders, and to appoint the chief operating officer with rank of president. The second part of the Bill provides for co-operative plans between the Canadian Pacific and Canadian National Railways to avoid unnecessary and uneconomic services, while the third part makes provision for the appointment of an arbitral tribunal to adjudicate between the two railways in the carrying out of the Act. In introducing the Bill Mr. Meighen stated that while the Government desired its early passage, it was not absolutely wedded to any clause, and offered the measure to the calm and unbiassed consideration of the Senate.

## The Gebel Aulia Barrage.

IN a Journal note of January 22nd we recorded the decision of the Egyptian Cabinet approving the scheme for the construction of a new barrage on the White Nile at Gebel Aulia, about 30 miles south of Khartoum. According to an official message from Cairo, it is now stated that tenders for the construction of the dam are to be invited for November 15th and that the adjudication will be made on February 15th next year. The engineers for the scheme are Coode, Wilson, Mitchell and Vaughan-Lee, of Westminster. It may be remembered that the scheme has been approved no less than three times since 1914, and the hope may be expressed that it will now go forward. The new barrage will supply Egypt with an additional 2,000,000,000 tons of water and will form a sister reservoir to the Sennar barrage, which supplies water from the Blue Nile to the Gezira irrigation scheme. It will constitute another important link in the vast scheme of irrigation for Egypt and the Sudan.

## French Railway Amalgamation.

A PROPOSAL to amalgamate all the French railways has been presented to the companies by Monsieur Daladier, Minister of Public Works, who declares that he can see no way of extricating them from the difficult situation in which they find themselves, except by bringing under one management all the systems, including the State and Alsace-Lorraine railways. The Minister, however, does not indicate whether the management would be undertaken by the State, or by a company holding a concession from the State, as is the case with the existing companies, or by other means. In his opinion the situation has become hopeless. He estimates that the deficit of all the railways this year will be something like 4600 million francs. During the past ten years it has been rapidly increasing, and the total has now reached 15,000 million francs. This he attributes partly to the heavy financial charges on the railways, and partly to the economic crisis and the competition of road traffic. The proposed amalgamation has been rejected by the companies, and the Minister has now taken the matter before the Commission of Public Works with a view to the elaboration of a plan that may be presented eventually to Parliament. The companies ask for relief from the State tax of 32·5 per cent. on passenger fares and from the obligation imposed on them by the State to carry mails under onerous conditions and to reduce fares and even to allow free passes to a considerable body of privileged citizens. All they require is liberty to run the railways on business lines without interference from Parliament. They have shown that, relieved of existing disabilities, the railways could pay their way, but that would involve a readjustment of working hours, wages and railway rates which the Socialists refuse to accept. The companies, therefore, find themselves with their backs to the wall.

## New Rectifier Sub-station at Ilford.

ON Thursday afternoon, November 3rd, a new sub-station was opened at the Ilford Town Hall. Eventually it will contain two 1500 kW steel tank mercury arc rectifiers, with their transformers; but at present only one rectifier has been installed. The plant converts from 6600 volts, three-phase, 50-cycle A.C. to 470/500 volt direct, and balancing is done on the three-wire system by means of a 150 kW balancer. The whole of the equipment was supplied by the General Electric Company, and a special feature of the rectifier is the anode seal, which has made it possible to dispense with water-cooled anode radiators, notwithstanding that the rectifier has to carry 3750 ampères for two hours. The equipment is designed so that it can be operated by remote supervisory control apparatus from the Ley-street station, or, alternatively, it may be automatically controlled. In the former case the operation of small control keys on the remote control panel at Ley-street results in signals being sent to the Town Hall sub-station, where relays start and stop the rectifier. In the latter case the plant is started up by a voltage relay operated from the D.C. bus-bars, and is shut down by an underload relay. Means are provided on the Ley-street control board to suspend automatic operation if conditions should make it desirable. For testing and other purposes the plant can also be operated by local push-buttons, and a single three-way controller on the control panel in the sub-station sets all the apparatus for any one of the three methods of control mentioned. The supervisory control equipment is designed in accordance with the G.E.C. "three-point tandem system," as developed at the company's telephone works at Coventry.

## The French Battleship.

THE construction of the 26,500-ton battleship "Dunkerque" was authorised by the French Parliament last year after opposition from supporters of the then generally accepted naval policy which excluded big ships on the ground that the home and Colonial defence could be best assured by small surface and submarine craft, fast cruisers and an efficient air force. That policy had to be modified following upon the successful results claimed to be obtained with the German 10,000-ton heavily armoured cruisers that were regarded as having outclassed the French cruisers of the same tonnage. The French Marine countered the German move by preparing plans for three battleships to come within the total tonnage allotted to France at Washington, and it is reported that these ships will attain a speed hardly inferior to that of the small German "battleships," while the armament will consist of eight 330 mm. guns in two quadruple turrets. Monsieur Georges Leygues, Minister of Marine, last week signed the contract for the new battleship, which will be put under construction immediately. At the same time, the Minister announced that he intends to push forward the programme of naval construction which has been partially held up by the truce, and orders for two 1500-ton submarines have been passed on to Cherbourg. As Germany is putting in hand the new "Brunswick" light battleship, there is promise of renewed activity in naval armaments at a time when other countries are seeking to reduce them.

## Physics in Meteorology.

IN a lecture on "Physics in Meteorology," presented by Dr. Simpson to the Institute of Physics last Wednesday, November 2nd, the author stated that when large and violent explosions occurred it was noticed that the sound was loudest near the origin and then decreased, as was to be expected, until at a certain distance, about 60 miles, it could no longer be heard. The surprising observation, however, was made that at distances of more than 120 miles the sound was again audible. After the war much work was done to try to find an explanation of this curious effect. In this country Dr. Whipple, of Kew Observatory, organised an investigation in which university students at Sheffield, Birmingham, Bristol, Nottingham, and Cardiff recorded with delicate instruments the sounds made when large guns were fired in Shoeburyness, near the mouth of the Thames. The result of this work had shown that the old idea that the upper atmosphere—the stratosphere—was cold throughout could no longer be held. The stratosphere was cold up to a height of about 25 miles and then it became warm again and at great heights became even warmer than at the surface. Dr. Simpson, discussing atmospheric electricity, described the electrical field which always exists even in fine weather near the earth's surface. He said that this field was probably caused by the fact that the conducting layers in the upper atmosphere—the so-called Heaviside and Appleton layers—were maintained at a potential of several million volts above ground potential. In conclusion, Dr. Simpson described some recent experiments at Kew Observatory which indicated that the ionisation of the lower atmosphere was not uniform, but that the ions occurred in parcels. This observation, he said, was likely to have an important bearing on the theory of the ionisation of the atmosphere.

## Carlisle Bridge.

LAST Thursday, October 27th, the reconstructed bridge over the Eden at Carlisle was declared open by the Mayor. The old bridge, designed by Sir Robert Smirke and erected between 1812 and 1815, was only 35ft. wide, and as it formed a link in one of the most important roads to the North and to Scotland, it was found to be inadequate to meet the needs of present-day traffic. As reconstructed the width has been doubled and footpaths 10ft. wide have been formed. The carriageway is thus able to accommodate comfortably five lines of traffic. The old bridge was built of stone brought from Cere Quarry, a few miles north of the border, but as this quarry has not been worked for the last seventy years supplies from that source were not available. Greenlow Quarry, in Northumberland, where the stone is of similar quality, provided the necessary additional material. As the bridge is of considerable importance, the Ministry of Transport agreed to contribute 75 per cent. of the cost of reconstruction, £60,000. Although the bridge is now opened, work is still proceeding upon the laying out of gardens at the northern end.

## Professor J. Hollingworth's Appointment.

THE Manchester City Council and the University of Manchester have approved the appointment of Mr. John Hollingworth, D.Sc. (London), M.A. (Cambridge), M.I.E.E., to the Chair of Electrical Engineering in the University and in the College of Technology, in succession to Professor Miles Walker, M.A., D.Sc., F.R.S., who has retired. Professor Hollingworth has been Scientific Assistant at the Radio Research Station of the Department of Scientific and Industrial Research, Slough, since 1928, and from 1921 to 1928 was on the staff of the National Physical Laboratory, Teddington. He had previously been on the staff of the College, first as an Assistant Lecturer and later as Lecturer in Electrical Engineering. Professor Hollingworth's researches include work on a physical interpretation of the Bessel Function of zero order; the measurement of the electric intensity of received radio signals, for which he was awarded a premium by the Institution of Electrical Engineers; the propagation of radio waves, for which he was again awarded a premium by the Institution of Electrical Engineers; the polarisation of radio waves; a long-wave radio intensity measuring set; some characteristics of short-wave reception; and a portable radio-intensity measuring apparatus for high frequencies. During the war Professor Hollingworth was engaged at the R.N.A.S. Air Station, Cranwell, and was later at the R.A.F. Experimental Establishment, Biggin Hill.

## The Duty on Copper.

IN the House of Commons on Monday, October 31st, in the continued discussion on the Ottawa agreements, Mr. Hore Belisha, Financial Secretary to the Treasury, speaking for the Government, gave further particulars of the Conference held at the Board of Trade, with regard to Empire copper supplies, at which 90 per cent. of the whole copper industry was represented. In the agreement reached, the Conference said, continued Mr. Hore Belisha, that "the intention being to ensure the progressive change-over from non-Empire to Empire copper, the consumers agree to give every possible assistance to the producers (including the maintenance of a technical committee—on which representatives of the producers will be welcomed—for the study and discussion of the problems arising) in their endeavours to satisfy the consumers' requirements in respect of quality; and further they will from now onward, as far as lies in their power, purchase from Empire producers in preference to non-Empire suppliers." They had also reached a definition of world prices. Generally, they had undertaken to accept the principle that the United Kingdom consumers should not be at a disadvantage compared with foreign consumers. That, said Mr. Hore Belisha, was a most promising outcome of the Imperial Conference.

# CHURCHILL CENTRELESS GRINDING MACHINE

(*For description see opposite page*).

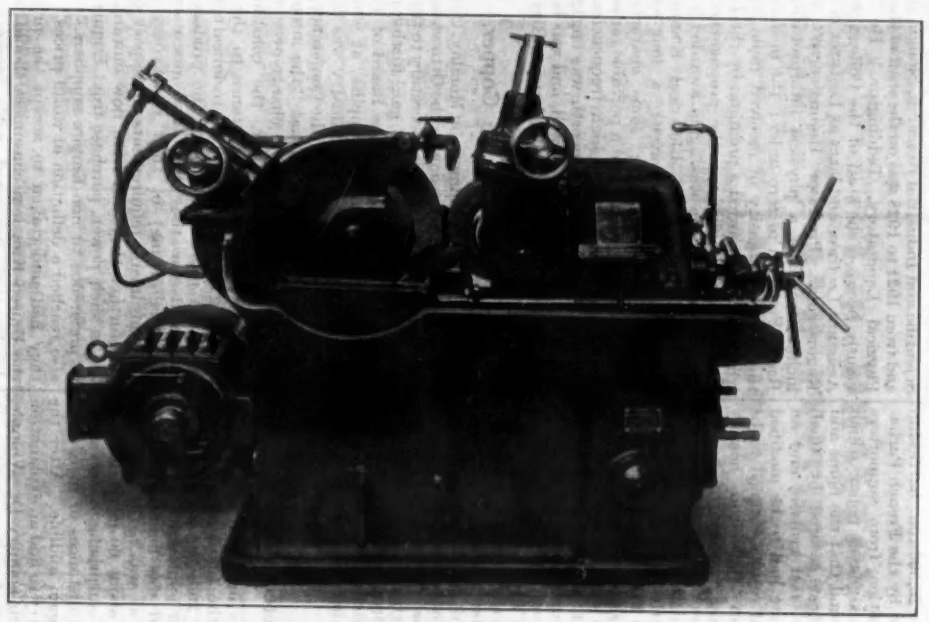


FIG. 35—FRONT VIEW

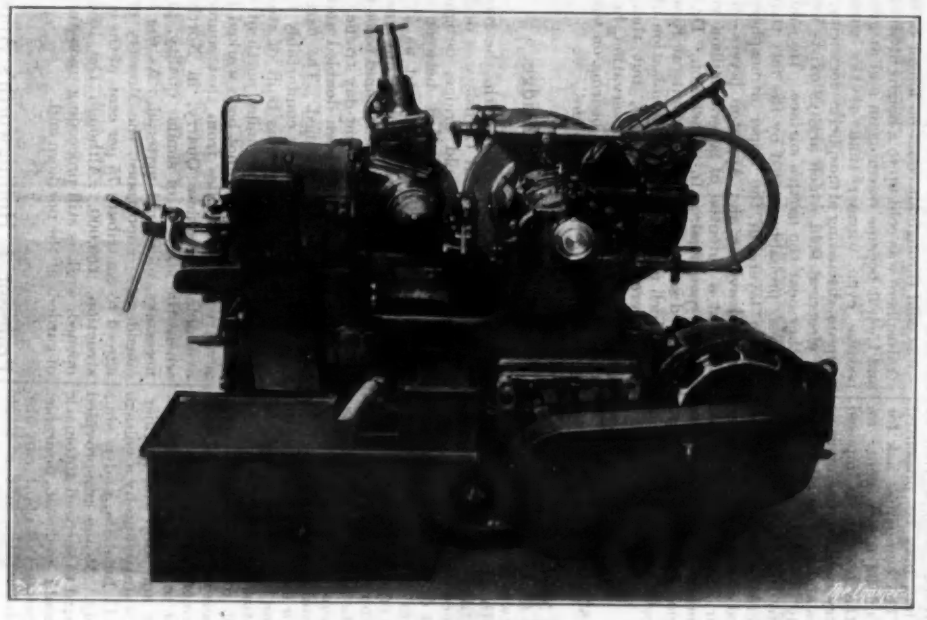


FIG. 36—REAR VIEW

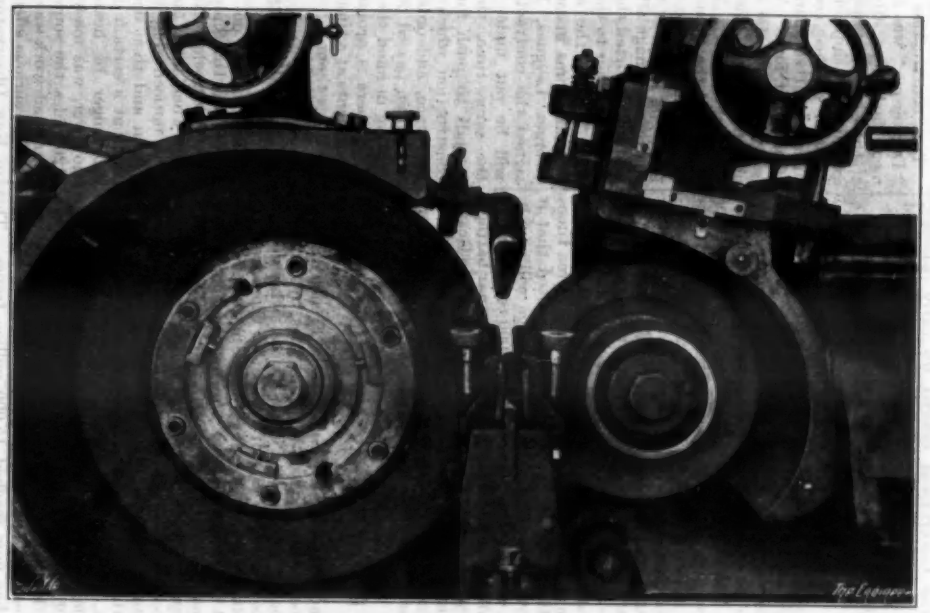


FIG. 37—GRINDING AND CONTROL WHEELS

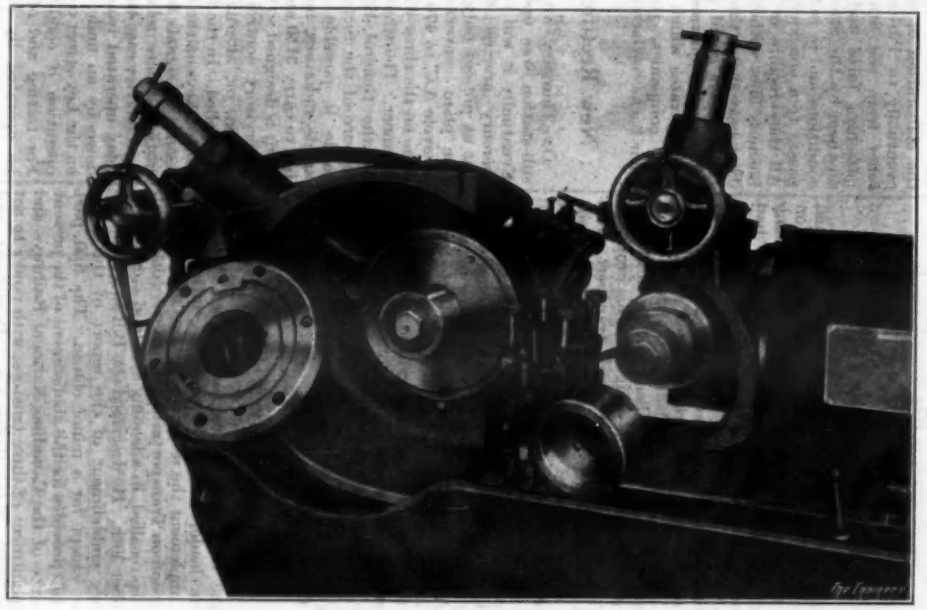


FIG. 38—VIEW SHOWING WHEELS REMOVED

# Precision Grinding Machines.

No. VII.*

CENTRELESS GRINDING MACHINES (*continued*).

THERE are two ways of bringing the work to size in a centreless grinding machine. Either the grinding wheel may be fed in towards a fixed control wheel or the control wheel may be fed towards the grinder. The latter method is adopted by the Churchill Machine Tool Company, Ltd., for the machine illustrated by Figs. 35 and 36 on page 448. These two engravings show the back and front view respectively of a machine capable of taking work up to 3in. in diameter for through feed and 4in. for short lengths. The grinding wheel is 20in. and the control wheel 12in. in diameter and the usual width of wheels fitted is 4in., though 8in. wheels can be accommodated. Direct motor drive through a chain or belt drive machines are available, that illustrated having a motor mounted on the base. The power required depends upon the nature of the work and the width of the wheels and lies between 15 and 25 H.P. While

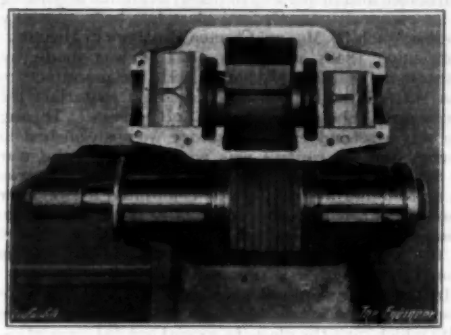


FIG. 39—GRINDING SPINDLE

the grinding wheel runs at about 1200 r.p.m., the control wheel has twelve speeds, ranging from 12 r.p.m. to 300 r.p.m.

In the tone engraving Fig. 39 the grinding spindle of the machine is illustrated. It will be seen that it runs in plain bearings of the half-box type. The lower halves are anchored in place by screws, but the top halves are full floating. Since it is driven from below by a Texrope drive, the spindle tends to be held down on the bearings. End thrust is taken up by a double row ball bearing at the end of the spindle furthest from the wheel. That the bearings are receiving the proper amount of lubrication can be seen through sight windows mounted on the top of each. The control wheel spindle, as shown in Fig. 42, is carried on conical roller bearings. This arrangement makes adjustment of the spindle a simple matter, since it is only necessary to remove the end cover, unlock the spindle nut washer, and tighten up the nut. The bearings are grease lubricated. A plain bearing type of control wheel head is fitted to some machines. Its design is similar to that of the grinding wheel spindle.

On any grinding machine it is of the greatest importance that the wheel should be correctly balanced, but it is even more imperative that it should be so on a centreless than on an ordinary machine. To obviate the likelihood of trouble owing to this cause the grinding wheel is mounted on the spindle with a balancing collet, as shown in the two tone engravings, Figs. 37 and 38, on page 448. Three movable weights are accommodated in an annular groove in the outer ring of the grinding wheel collet, and by simple adjustment of them the wheel can be caused to run correctly and smoothly. Since it never runs at the high speeds required for the grinder, the control wheel does not need such a refined balancing device. The ease with which access can be obtained to the wheels is well illustrated by the two engravings under discussion, which also show the

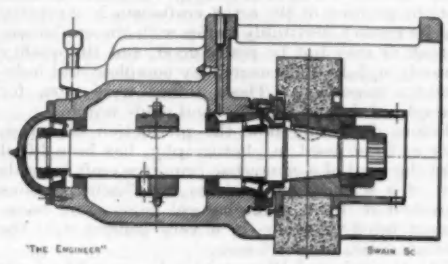



FIG. 42—CONTROL WHEEL SPINDLE

arrangement of the adjustable work guides, the work rests, and the positions of the diamonds for wheel dressing. The trueing fixture for the grinder is mounted towards the back of the top of the wheel guard. The diamond is carried in a nib which fits into a long adjustable sleeve. By means of a screw the sleeve can be clamped in any desired position. At the top end of the sleeve a small hand wheel and dial provide micrometer adjustment of the diamond. The whole affair is mounted on a slide, along which it can be traversed by the use of a hand wheel. The

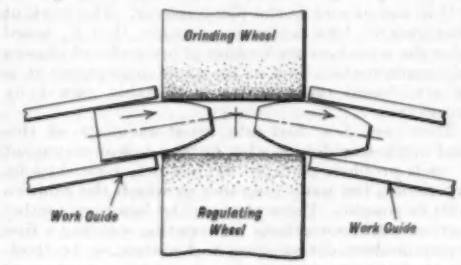



FIG. 43—EFFECTS OF INACCURATE GUIDE SETTING

ways. The diamond can be mounted on the guard and traversed across the wheel at the point at which the work itself will be in contact with it, in which case few precautions are necessary, or the wheel may be trimmed at some other point, as is the case in the Churchill machine. When the diamond operates upon the top of the wheel adjustments must be made to allow for the relative positions of the work and the control wheel. For any given angle of the control wheel housing—determined by the nature of the work—the wheel trueing fixture must be rotated around its own very nearly vertical axis to the same angle. This movement will ensure that the work bears against the whole width of the grinding wheel face. Similarly if the line of contact of the work and the control wheel is to be, say, $\frac{1}{4}$in. above the centre line of the wheels, the whole trueing fixture must be offset sideways away from the grinding wheel by an equal amount. The two scales by which these adjustments are made can be seen in the photograph reproduced in Fig. 37. The gearing in the drive of the control wheel is so arranged that its speed can be rapidly altered to the maximum for trimming purposes.

The two engravings to which reference has just been made show also the means adopted for setting the work guides in position by the adjustment of thumb knobs. On the grinding wheel side the guides are placed to clear the work by $\frac{1}{16}$in. to $\frac{1}{8}$in., while the clearance on the other side should be no more than half to one-thousandth of an inch. The importance of setting the guides accurately is indicated by the engraving Fig. 43. Taper on the front end of the work is caused by the work guides on the entrance side being deflected towards the regulating wheel. Similar deflection of the exit guides causes taper of the back of the work. Guides deflected towards the control wheel cause the work to be ground hollow in the centre. It is essential also when infeed grinding that the work support blade should be truly horizontal or the work will be ground taper. Many of the causes of chatter marks are to be traced to this part of the set-up for grinding. The principal causes of the defect, according to the Churchill Machine Tool Company, Ltd., are :—Grinding too high above the centre line of the wheels ; too hard or too fine a grinding wheel ; too steep an angle on work support blade ; too thin a work support blade ; play anywhere in the set-up owing to loosely clamped members ; loose fit of the grinding wheel mount on the spindle ; vibration ; grinding wheel out of balance ; or improper adjustment of grinding or control wheel spindles.

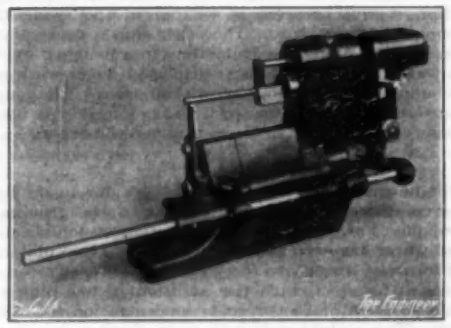
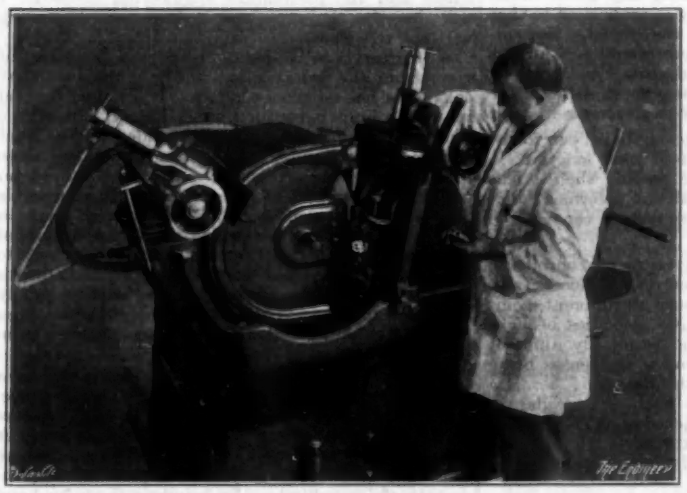
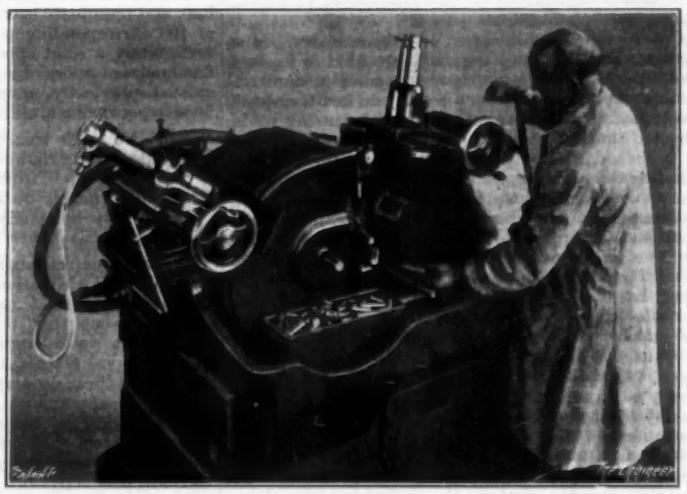


FIG. 44—CONCENTRIC GRINDING ATTACHMENT





FIGS. 40 AND 41—THROUGH-FEED AND IN-FEED GRINDING ON A CHURCHILL MACHINE

The two methods of grinding on a Churchill centreless machine are illustrated by the tone engravings, Figs. 40 and 41. A special attachment is being used for through-feed grinding, consisting of a V section chute into which the pieces are fed by hand. The chute guides the pieces between the guide plates,

* No. VI. appeared October 28th.

whence they travel between the wheels to be collected on another chute on the other side and delivered, finished, to a tray. Grinding thus takes place continuously. For shouldered work use is made of a long lever to one side of the machine. The pieces are fed in by hand and when the lever is brought over ground to size. Returning the lever causes the withdrawal of the control wheel and the ejection of the finished piece into a collecting tray.

Concentric grinding is performed on the Churchill machine by the use of the attachment illustrated in Fig. 44. The principle of operation consists in supporting the work on an arbor which is free to float in the horizontal plane, but is rigidly fixed in the vertical plane. The arbor is placed in the same position as an ordinary work rest and is mounted on the same slide as the control wheel head. Although the arbor may be termed floating, spring pressure tends to hold the work towards but not in contact with the control wheel. When a component is mounted on the arbor and the control wheel is advanced towards the grinding wheel, contact is first made between the control wheel and the work. The arbor is thus thrust towards the grinding wheel, which first removes the high points of the work and finally brings it round and concentric with the bore. One end of the arbor, it will be seen, is secured in the swinging member of the fixture. The other end, if necessary, can be also supported from the same member by a bar which is automatically displaced when work is to be inserted or removed from the arbor. The long rod at the base is connected with the infeed lever and operates the ejector to be seen above the arbor.

### Grinding Coolant.

Some interesting recommendations are made by the company as to the ingredients of the grinding coolant. For general work a solution of soluble oil and water has been found satisfactory. One pint of oil for every twenty to forty pints of water is recommended for steel, with the addition of one pint of soda solution of 25 per cent. concentration for cast iron. The coolant may be improved when grinding aluminium by the addition of two pints of paraffin instead of the soda, since the former tends to keep the soft metal out of the pores of the wheels and also prevents glazing. Fibre should be ground with paraffin as a coolant, while rubber, carbon, celluloid, casein, and similar materials are preferably cooled by the use of mains water, the waste being directed either directly into the sewer or alternatively into a large settling tank, since the stock removal is high and standard tanks are not sufficiently large.

*(To be continued.)*

## Mechanical Engineering Applied to the Making of Lenses.*

Nearly every modern productive industry depends upon the use of machinery or tools which embody principles of mechanical science. In this sense almost all industry is based upon mechanical engineering, and that is why the knowledge and interests of the members of the Institution, who are the tool makers for all industry, are so exceptionally varied.

Thinking that it would interest you more than would any other subject within my knowledge, I shall speak in this address on the application of mechanical engineering to the production of lenses, particularly photographic lenses.

One of the characteristics of that industry is the extraordinary accuracy regularly attained in its best products. One-thousandth of an inch is approximately the limit of accuracy which can be attained in the ordinary machining of metal with cutting tools. One ten-thousandth of an inch represents the order of accuracy generally attainable in such work by grinding or lapping; for example, in the work of the fine tool maker and the watchmaker. Here are two knife-edge gauges, made to demonstrate to the King and Queen these dimensions of one-thousandth and one ten-thousandth of an inch. Each comprises a hardened and lapped straight-edge and a piece of steel, hardened and lapped to a plane and placed over the knife-edge, so that light can be seen through the gap between them. The one gauge has a gap of 0·001in. and the other of 0·0001in. An interesting thing is that diffraction makes the smaller gap appear nearly as large as the other. Similar sight gauges are valuable in a workshop for inspecting profiles. If the knife cuts off light an accuracy of at least 0·0001in. has been attained. This is the highest order of accuracy attained regularly in any manufacturing industry excepting perhaps the optical industry alone. But in making the best photographic lenses and other optical instruments of precision, the accuracy of the surfaces of the elements (such as lenses, prisms, and mirrors) must be from 0·00001 to a few millionths of an inch (measured in wave-lengths of light); and this accuracy is attained in every-day working, not only by skilled artist craftsmen of long experience, but by less skilled persons doing repetition work by the aid of special appliances, the products of mechanical engineering.

When I entered the optical industry some forty-five years ago, after training as an engineer, I was greatly impressed by the primitive methods then in use, and the wonderful work done by a few artist craftsmen. Alvan Clarke, who constructed the great telescope objectives of the Lick and Yerkes Observatories, appeared to have no tools much more elaborate than those one could find in a country blacksmith's shop. But the product of the artist craftsman is expensive and its quality inevitably varies with the craftsman. It may or may not be really good, and the quality is rarely upheld and ensured by complete and independent inspection. These things were true, for example, of the old English hand-made watch.

Before describing how the production of lenses, such as those used in photography, has been lifted from the level of a somewhat primitive craft towards that of a science, and put, as Sir Charles Parsons expressed it, upon a mechanical engineering basis, I must briefly describe in a very general way the characteristics of such lenses.

*The Designing of Photographic Lenses.*—The function of a photographic lens is to form real images of objects by receiving light from each point of the object and condensing it to a corresponding fine point properly located in the image.

The problem of satisfying this simple statement in designing the best photographic lenses is exceedingly complex. No true mathematical solution is known nor perhaps ever will be. The only really perfect optical instrument is the plane mirror. The work of photographic lens design is scientific, that is, based upon the conscious application of principles of physics and mathematics, but in its main inspirations it is an art, based on tradition and habit gained by experience.

There are few first-rate artist-scientists of this kind in the world, men who, having a clear statement of each problem perceive by instinct, nourished by experience, the main direction in which the solution must be sought. These pursue it by laborious mathematical work, sometimes for months, securing a first approximation, determining its deviation, and correcting their course accordingly, again by a mixture of art and science.

And of these few men it may be truthfully said that the best are Englishmen. For during the last twenty years nearly every single important advance in this field, nearly every step in providing faster lenses and better definition, has been made in England.

A perfect photographic lens would—

(*a*) Receive a large amount of light from the object;

(*b*) Condense to a mathematical point all the light which it received from each mathematical point of the object;

(*c*) Arrange the image points in correct order and relative positions so as to render the image a true visual replica of the object;

(*d*) Set all points of the image in one plane (for photographs must generally be flat);

(*e*) Illuminate all points of the image correspondingly with those of the object.

It is physically impossible to devise a lens which has all these virtues simultaneously.

Consider a solid sphere of any transparent homogeneous material such as glass. That would act as a lens, and have this one supreme virtue, that it would present the same aspect to all points of the object alike, and would both arrange the points of the image in correct relative positions along any given radial line, and illuminate each strictly in proportion to that of the corresponding point of the object. But unfortunately a solid spherical lens would not form a flat image of a flat object or a distant scene, but one curved spherically, nor would any point of the image be sharply defined, and this for two reasons—

(1) No single lens, of whatever shape, can focus, simultaneously, light of different wave lengths.

(2) The wave fronts after passing such a lens would no longer be spherical but deformed, and, unless they be spherical, they cannot converge to mathematical points.

These two defects are respectively termed chromatic and spherical aberration. To cure them necessitates the use of at least two glasses of different compositions, such that the relative velocities of light of different wave lengths are substantially different in the several glasses, the forms of the lenses being adapted to these properties of the glasses.

Lenses compounded in this way, of two glasses, commonly suffice for the objectives of telescopes, whose angle of view rarely extends to 10 deg. and whose apertures are generally about one-twelfth the focal length (f/12).

But with the best photographic lenses the angle of view sometimes reaches 100 deg. Apertures have now reached f/1·3, and such lenses must be substantially free from distortion and image curvature, chromatic and spherical aberration, astigmatism and coma (these two being varieties of spherical aberration affecting light passing obliquely to the lens axis and due to the emerging wave-fronts not being surfaces of revolution). The problems of design are, therefore, immensely more complicated with photographic lenses than they generally are with other optical instruments.

The designer has available: (*a*) Different kinds of glass; (*b*) their order in the system; (*c*) the powers of the lens elements; (*d*) their order in the system; (*e*) the forms of the lens elements, *e.g.*, bi-convex, bi-concave, meniscus, &c.; (*f*) the curvatures of the lens surfaces; (*g*) the thicknesses of the elements; (*h*) the air spaces between the lenses.

It has been usual, for reasons which we shall appreciate later, to employ only spherical surfaces in lens design. Astronomical telescope objectives and some others have, however, been "figured" by removing additional material from selected zones or areas of the lens, generally by additional polishing, to perfect the performance of the lens. But this is very laborious work unsuited to the commercial production of photographic lenses generally. Nevertheless, it is possible that the next great step in photographic lens design will involve the use of aspherical surfaces; but this cannot be effective until the mechanical engineer has provided means for producing such surfaces commercially with an order of accuracy of, say, 0·00001in.

*Optical Glass.*—The properties which make glass essential for lenses are: its transparency, homogeneity and permanence; the fine polish it will take and retain; and the variety of optical properties (refractive and dispersive indexes) available according to its composition. Optical glass has been specially made as such by Messrs. Chance Brothers in Birmingham since 1848, and from 1827 it was made by Mantois in France. About 1881 its manufacture was started in Jena to provide new materials for Professor Abbe's microscope objectives. During the war a second English factory was established in Derby, and its control was acquired after the war by Sir Charles Parsons (who, among other things, was an astronomer and son of the celebrated astronomer Lord Rosse), who desired especially to produce large discs for astronomical objectives. Optical glasses of the very finest qualities are obtainable in this country from either Birmingham or Derby.

In producing optical glass, the necessary silicate base is fused in a crucible together with the metallic salts which give the glass its special optical properties, and the mass is slowly stirred by a mechanically operated stirring rod. Difficulties to be avoided include contamination from the pot and rod, segregation of the glass constituents and the inclusion of bubbles and dirt. As it has not been found practicable to extract the finished glass in a plastic state from the pot, the whole is permitted to cool slowly and then broken up with a heavy hammer. The pieces of pot are knocked off the lumps of glass, the useful lumps of clean glass are selected and reheated on the sand-strewn floor of a furnace until they are plastic, and are then pressed either into the form of thick plates, or, between suitable moulds, roughly into the form of lenses. The material is then annealed, perfect annealing being essential; and this is a slow process owing to the low heat-conductivity of glass.

Since each pot of optical glass has a distinct individuality and differs appreciably from every other pot of glass, the moulded pieces from each pot are stamped with a distinguishing number and their identity is preserved through all the subsequent processes of manufacture. In order to ascertain whether the glass is perfectly annealed and free from bubbles and dirt inclusions, it is the best practice to grind and polish the plates on both sides and then to view them by transmitted polarised light, as is done by Professor Coker with his celluloid models.

*The Production of Lenses (Glasswork).*—In order to illustrate both the primitive methods of making lenses and the mechanical engineering methods, I will describe the processes in sequence, beginning with the raw glass.

A feature which distinguishes the working of glass from the working of metals is the fact that cold glass has no plastic phase. If strained beyond its elastic limit it ruptures immediately. Its elastic limit and ultimate stress are coincident. And that fact makes it impossible to cut glass in the sense in which we cut metals, for since there can be no plastic deformation of the chip, it is impossible for the edge of a cutting tool to penetrate glass, as it does in metal, to determine the exact surface of separation of the chip from the work. What we do in shaping glass, when "cutting" it with diamonds or grinding it with abrasive grains, is very largely to follow the process used by prehistoric men who "knapped" flints and broke conchoidal flakes from the surfaces of these stones.

The first step in making a lens element from a plate of glass is to form the lens blank as a disc. The primitive way of doing this is to cut a square of glass with a glazier's diamond, then with soft iron pincers to break away the corners of the square until the disc is roughly circular, and finally to smooth the rough edges by grinding them by hand on a cast iron lap fed with wet abrasive such as coarse emery or carborundum.

Over forty years ago I investigated systematically the problem of sawing glass by means of sheet metal saws, formed as circular discs and as tubes, whose edges are charged with diamond dust.

The variables were: (*a*) The best metal for the saw blade; (*b*) its best physical condition; (*c*) its best thickness; (*d*) the best type and source of diamond; (*e*) the best size of diamond particles and how to procure these; (*f*) the best way of securing the diamond particles in the edge of the saw; (*g*) the best linear speed of cutting; (*h*) the best rate of

* The Institution of Mechanical Engineers.—Address by the President, William Taylor, O.B.E., October 28th.

penetration of the saw; (*i*) the best manner of controlling the rate of penetration; (*j*) the best coolant; (*k*) getting rid of detritus.

[Mr. Taylor at this point illustrated by means of lantern slides the modern method of cutting lens discs by means of tubular saws which he devised as a result of his investigations.]

The next step in making a lens from the disc of glass is roughly to grind its two faces to the requisite curvatures and with their common axis sufficiently central in the disc. The primitive method, which is still used in many works, employs a cast iron tool, a counterpart of the surface to be ground, which is rotated on a spindle and surrounded by a box in the bottom of which are coarse abrasive and water. These are thrown intermittently on to the tool by the operator's left hand while with his right hand he keeps the disc of glass pressed against, and moves it to and fro radially on, the tool. Much skill must be exercised in trying to keep unaltered the curvature of the tool.

A maker of photographic lenses has to form lens curvatures of almost any radius, from say, a few tenths of an inch to infinity. He may be said to describe circles whose centres are sometimes outside his workshop, sometimes outside his city, and sometimes among the stars.

When carborundum and the bonded carborundum wheel were first introduced, I applied them to grinding lens surfaces, and thus dispensed with the metal roughing tools and their attendant evils.

The applied geometry is illustrated in Fig. 1.

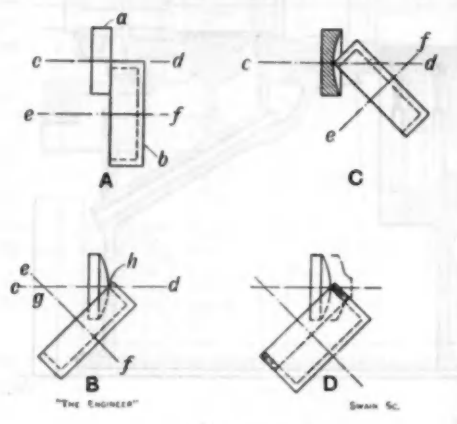



FIG. 1

At A, *a* is a rotating disc of glass shown in side elevation, and *b* is a cup-shaped abrasive wheel. When set as shown, with the glass axis *c d* parallel to and in one plane with the wheel axis *e f*, the wheel generates on the glass a plane surface. That is geometrically a spherical surface of infinite radius.

At B the wheel axis is inclined to and intersects the work axis at *g*, and the annular edge of the wheel crosses the work axis. In this position the wheel generates a spherical convex surface of radius *g h*. At C the wheel is inclined in the opposite direction to grind a concave surface. At D it is shown that as the wheel wears, the thickness of the lens and the radius of its surface increase equally.

By this means one can, without special laps, grind lenses to any required curvature, and any number can be ground in succession to one uniform curvature, provided only that the wheel is advanced along its axis to compensate its wear. And if the rear surfaces of all the lens blanks be successively positioned alike, it is only necessary to maintain the lens thickness uniform to maintain also uniformity of curvature. A test of one is equally a test of the other.

The equation of curvature is $R = \frac{D}{2 \sin a}$, where R is the radius of curvature, D is the diameter of the abrasive annulus at the work axis, and *a* is the angle between the axes of work and wheel.

After the first surfaces of a batch of lenses have been ground in this way, the blanks are returned to the chucks, in reversed direction, and their second surfaces are ground.

The processes of smooth grinding and polishing are performed by means of part-spherical laps of the general forms shown in Fig. 2, and here we touch the real reason why lens surfaces are generally of spherical form. The only abrading means by which the requisite regularity of lens surface can readily be produced is a lap which makes complete surface contact with the lens at all times, and not merely line or point contact. And the only possible form of lap and lens which can under these conditions be moved in various directions relatively, to abrade one another, is the spherical form.

In the primitive way of using such a lap the work is mounted at elbow level on the top of a post fixed to the floor, the lap is provided with a central knob, and the craftsman, with a thumb and finger embracing the knob and his two hands putting pressure on the lap, moves the lap to and fro, more or less radially over the work, and at the same time walks steadily round the post in order to distribute the rubbing equally round the lens surface. The orbit of the tool is thus roughly epicycloidal. At intervals he moves the lap a little round under his hands, so as to distribute the rubbing evenly upon the lap. To form a lens accurately within one or two wave lengths of light by these primitive means demands a length of experience and a degree of skill of which the craftsman is justly very proud.

It was to avoid the heavy labour of moving the tools for making large telescope objectives that machinery was first applied to this operation. The glass disc was attached to the upper end of a vertical shaft and slowly rotated. Two cranks were used to move the upper tool, and their connecting-rods were pivoted in common to the centre of the tool and disposed at right angles to one another. The crank shafts were belted together, so that they never returned to the same phase, and thus the orbit of the tool changed continuously between a straight line and a circle, and so back again.

Over forty years ago I experimented, by rubbing together flat discs of Bath brick (which quickly gave results) to determine whether this constant change in the quasi-epicycloidal motion between tool and work was really necessary. I found it to be useless; nevertheless, for thirty years lens-working machinery with the two cranks continued to be made, although the operators had acquired the habit of setting one crank pin concentric to its shaft, so that it acted as a fixed pivot and its connecting-rod as a mere link constraining the tool to move in the arc of a circle, But the fixed pin was not permitted to be passive. it continued to be rotated!

In machines of this kind the function of rotation of the work disc is to distribute the abrasion equally round the disc, the main function of the radial motion of the tool is to effect the rubbing; and the tool is pivoted to the connecting-rod, and not fixed to it, so as to permit the tool to be slowly rotated by the disc and thereby equalise the rubbing round the tool surface.

If a circular lapping tool be applied in this way to abrade a circular disc, and the lap and disc have the same diameter, the effect is gradually to change the curvature of their contact surfaces, the lower member being overlapped toward its margins, and the upper member being worn especially toward its centre.

Thus, for example, if we start with plane surfaces, the lower member will gradually become convex and the upper one concave, and this change will progress indefinitely. To secure stability of curvature, obviously the upper member (the lap in this case) must be smaller than the lower member; but how much smaller should it be? If only a little smaller, then the orbit of the tool's motion must be small and the rate of abrasion small. If very much smaller, then the tool's orbit will be greater, but its control of the regularity of curvature of the work surface will be impaired.

This problem was solved by means of the Bath

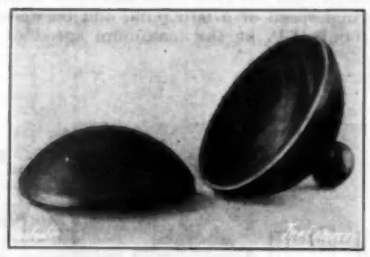


FIG. 2

brick discs. The diameter of the upper member was varied step by step. At each step the orbit of motion was adjusted until stability of surface curvature was secured, and then the detritus removed by rubbing for a fixed time was weighed. Thus it was proved that the optimum effect of abrasion and stability of curvature were obtained when the ratio of diameter of upper to lower member is about 5/6.

When glass has been sufficiently smoothed with fine abrasive and a metal lap, it is polished. Plate glass and spectacle lenses are commonly polished with rouge and water on felt-coated tools, but this would be useless for photographic lenses. These are polished with laps faced with pitch or waxes, extremely viscous solids which at any instant behave as though rigid, but which, nevertheless, conform slowly but accurately to the surface of the work. Experiments in the Leicester works laboratory have shown that the layer of glass removed in polishing a lens surface by these means is only about six wave lengths in thickness.

The means by which every surface of every lens is tested for curvature and regularity of form consists of working a very accurate counterpart of the desired lens surface in a disc generally of glass. This is placed in contact with the lens surface, and the contact is viewed by reflection in order to observe the so-called Newton's rings formed by interference of the light waves reflected from the two surfaces. If these surfaces conform only approximately they will show a series of concentric rings of colour, a fresh ring wherever the separation of the surfaces changes by half a wave length. If the surface under test is not truly spherical this will be revealed by the irregular spacing of the rings. If it is not a surface of revolution, the rings will be deformed. If there is only one ring, the surface conforms to the gauge within half a wave length. If the test gauge be defective as to its regularity of curvature, this will be revealed by moving the gauge on the lens surface, for if the defect follows the gauge it is a defect in the gauge.

One of the difficulties encountered with work of this accuracy is that of holding anything whatever without distorting it. No kind of mechanical holder or chuck is permissible with these lenses, and what is done is to cement them to holders by means of a layer of pitch. The solidity of pitch withstands the forces applied to the lens in grinding and polishing, while its property of flowing slowly ensures that the lens is held without strain.

But the pitch must have the right degree of viscosity and this must be uniform throughout the mass; the means of ensuring these things or mitigating the ill-effects of their absence was one of the secrets of the skilled artist-craftsman. During the war Leicester had to produce lenses of the highest accuracy in considerable quantities and for many purposes. The supply of skilled craftsmen was totally inadequate, and we had to find means by which unskilled help could do work at least as good as that previously done only by craftsmen of long experience. This was in its true and broad sense a mechanical engineering problem.

By employing discs of glass with two polished flats at opposite sides of their perimeters, and viewing the glasses by polarised light transmitted through the flats with an apparatus known as a Babinet compensator, we were able to see the strain produced in the glass when one surface was heated by applying hot pitch. We saw the strain released as the pitch and glass cooled, but if the pitch, or portions of it, were truly solid and not a viscous-solid, some strain remained permanently. If, on the other hand, the pitch were not sufficiently solid, the strain disappeared soon. Thus, a test for the quality of pitch was established, and we learned that it must be self-annealing at ordinary temperatures and, for example, retain some strain for half an hour, but none for an hour. For shop practice an equivalent test was substituted in the form of a Brinell test applied for a standard time.

And then we saw that the artistic method of the old craftsman had been essentially the same, for he chewed the pitch to test it—that is, he made Brinell tests with a time factor by means of his teeth! His was a qualitative rather than a precise quantitive method, and it took him many years to learn. But as an art based on tradition and upon habit gained by experience, in what respect we must hold it!

Besides holding individual lenses without strain, pitch is used for attaching numbers of lenses simultaneously to one holder with their surfaces conforming to one geometrical spherical surface, so that for economy they may be ground and polished together as one unit. But this, of course, is not possible with deeply curved lens surfaces, some of which must be worked singly.

Prior to the war lens-polishing machinery of the kind already referred to, comprising one or two cranks and connecting-rods to move the tool and weights to apply the necessary pressure, were in general use. But the excentricity of the cranks, which determined the size of orbit of the upper tool, the excentricity of that orbit with respect to the work—that is, the size of the epicycloid described by the upper tool on the lower one (commonly the work)—the respective rates of movement of the two members, and the pressures between them, were all varied according to such judgment as the operator possessed. The product varied greatly with the skill of the operator, and long experience was necessary to get good results. Much evil resulted from the inertia of the weights, which moved up and down as the attachment to the upper tool moved to and from the zenith of its vertical orbit.

During the war, in order especially that hundreds of thousands of binocular telescope objectives of the highest quality could be made by inexperienced girls, I reduced these variables by designing a machine which entirely eliminated the inertia effects of previous machines. It also eliminated all the variables but one, the pressure between the tool and the work. But for this it provided a measure of value, being graduated with a scale of pressures by which the machine could be set.

It was this substitution of science for art which enabled England to produce during the war very large numbers indeed of lenses for prism binoculars of a kind which, prior to the war, she imported from an enemy country. The quality of these lenses was uniform and of the highest standard, and notwithstanding the increase in labour rates and expenses generally, the cost was below the pre-war cost.

On this machine there was employed another device which, though stimulated into being by the war, I had conceived a generation before. The operation of feeding rouge and water to the lens-polishing tool had been performed with a hand brush. If the film of water between the polisher and work exceeds in thickness the diameter of the grains of rouge, no polishing can occur. If the film dries, the polisher heats and adheres to the lenses, and may tear them from the tool. Thus the operator has to exercise ceaseless care in watching his work, and the number

of spindles he can attend is very limited. Also the work is very messy.

The traction between polisher and work rises in value continuously as the polisher dries after being wetted. Obviously the traction is a function of the rate of polishing, and the object should be to maintain this as high as possible short of the danger point.

The rule must therefore be to apply the rouge and water continuously or frequently when, and only when, the traction is at a predetermined value short of the danger point. This cannot be done manually with certainty, but it is done by the device referred to in which a supply of rouge and water is kept in circulation in a closed circuit of pipes and provided with pneumatically closed valves. One of the two machine spindles is mounted with slight lateral freedom, so that it may be moved by the tractive effort between the polisher and work. Normally, this motion is resisted by a variable traction spring and a vent in the pneumatic system is closed and the water supply thereby cut off. When, however, the traction rises to any value predetermined by the setting of the traction spring, the vent is opened and water and rouge are supplied to the polisher. Thus the whole process becomes automatic, the operator is relieved from much strain, his work is more cleanly and respectable, he produces more and better work; and this is the normal result of applying to an art the science of mechanical engineering.

When the two surfaces of a lens have been polished and tested, the peripheral edge of the lens must be made cylindrical, of diameter to fit closely the cell in which it is to be mounted, and with the axis of the cylinder containing the two centres respectively of the two spherical surfaces of the lens.

The primitive way of doing this was to cement the lens by one face to a lathe chuck, to move the lens about on the chuck (before the cement set) until reflections from the two lens surfaces appeared stationary while the lathe rotated. The edge of the lens was then either ground by an emery-charged wet block of copper rigidly applied to the lens edge, or by turning it with a hand tool, commonly a "three-square scraper."

These primitive appliances have been replaced by modern devices, by which it is the regular practice to set the two centres of spherical curvature of lenses within 0·0002in. of the axis of the finished cylindrical edge, and to grind any number of edges in succession within 0·0003in. to 0·0005in., according to need.

And here, when we reach the problem of mounting a number of separate glasses concentrically in one mounting, and the subject of compensating, in each assembly, such small residual variations of glass constants, lens thicknesses, and curvatures as inevitably occur, I must stop for lack of time.

---

A SATISFACTORY lubricant for cold drawing must, according to Mr. H. A. Montgomery, be properly balanced, principally as to coefficient of friction and surface tension. The proper range of coefficient of friction is from 0·005 to 0·020. Surface tension is of the utmost importance, and should be as low as can be obtained. It is not difficult to make a lubricant having high film strength, which is usually controlled by increasing or decreasing the saponification of the fatted bases, or by the use of a solid lubricating material, such as lead carbonate, calcium carbonate, talc, &c.

# The Surbiton Waterworks.

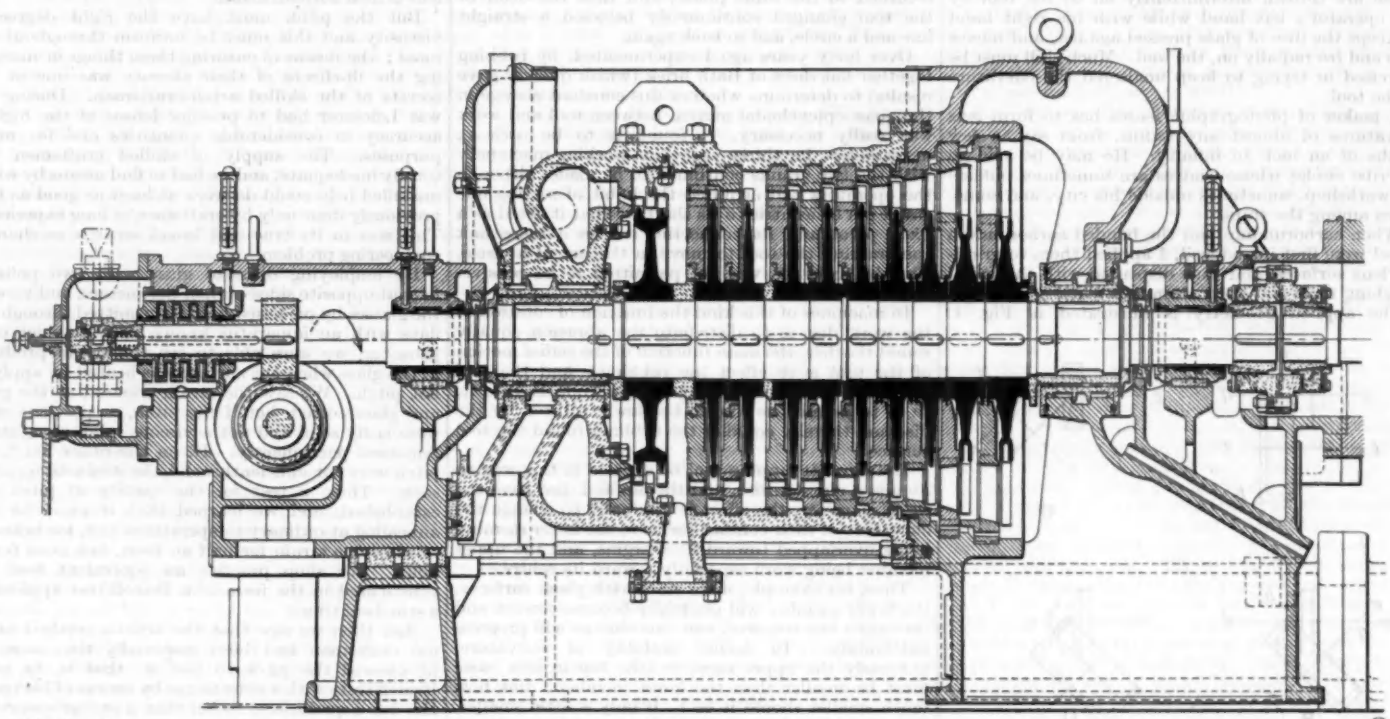
No. II. (*conclusion*).*

PUMPS AND TURBINES.

THE contractors for the main pumping machinery are Worthington-Simpson, Ltd., of Newark-on-Trent, who are the makers of the centrifugal pumps and the condensing plant. The steam turbines have been supplied by the Fraser and Chalmers Engineering Works, of Erith.

The turbines, of which we give a typical cross-sectional elevation, are designed for 250 lb. per square inch pressure and 600 deg. Fah. temperature at the stop valve. The normal vacuum is 28½in. Hg. The four sets are not quite identical in capacity; their output lies between 1400 and 1500 B.H.P., at the normal speed of 5700 r.p.m., and between 1850 and 2100 B.H.P. at the maximum speed of 6300 r.p.m. The expansion of the steam takes place in ten stages. The first stage is of the velocity type; all others are single-impulse stages. The diameters of the rotors varies from 24in. to 32in.

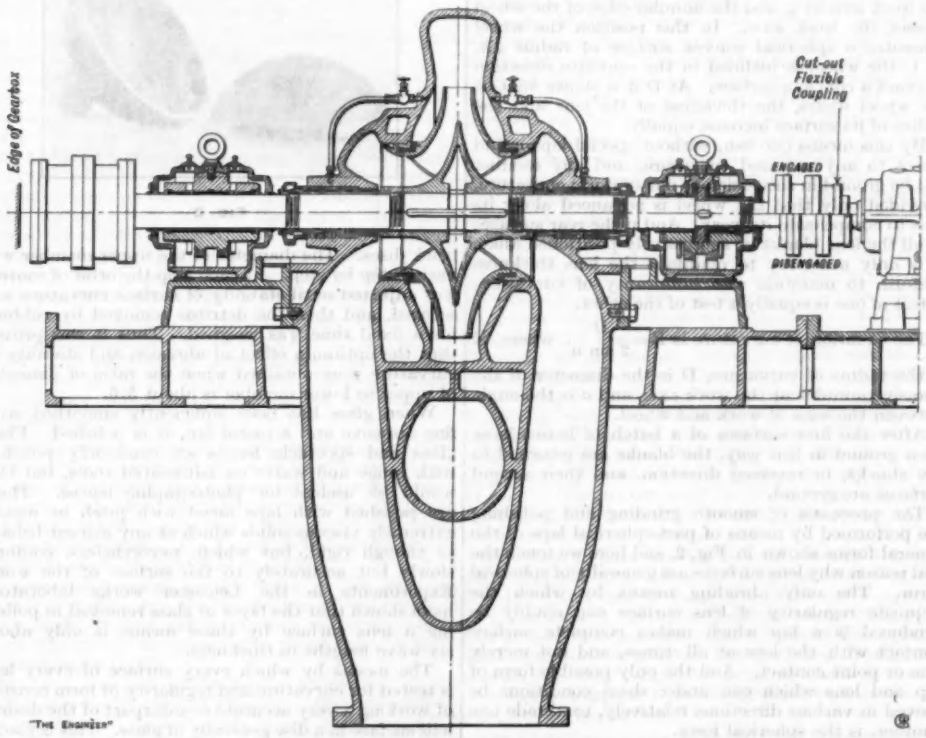
The steam chest, which is rigidly bolted to the bottom half of the turbine casing, contains the stop and emergency valve, the main throttle valve and an automatically operated overload valve. The main throttle valve is oil relay operated. The details of the steam chest, valves, and valve gear are clearly shown in our detail illustration, p. 454. The construction of the turbine follows the makers' standard practice, and all the moving blades are milled from solid bars and riveted to the discs. The discs after careful balancing were hydraulically pressed on to the shaft. The packings are all of the labyrinth type. Both main packings and the diaphragm packings in the superheated portion are of steel, but the diaphragm packings in the low-pressure part are made of brass.



"THE ENGINEER"

1500 B.H.P. STEAM TURBINE—FRASER AND CHALMERS

There is always a rotating sleeve interposed between the stationary part of any packing and the shaft, so that the latter is protected against rubbing that might cause distortion. The thrust bearing is of the multi-collar type, and the main bearings are white metal lined, and easily adjustable for alignment. Forced lubrication is used on all the bearings. The coupling between the turbine rotor and the pinion shaft of the gears is of the flexible claw type. The centrifugal speed governor, which is driven by worm gearing, has a speed adjustment of 10 per cent. above and below the normal speed. The turbine is arranged to trip on account of overspeed, failure of vacuum, or exces-

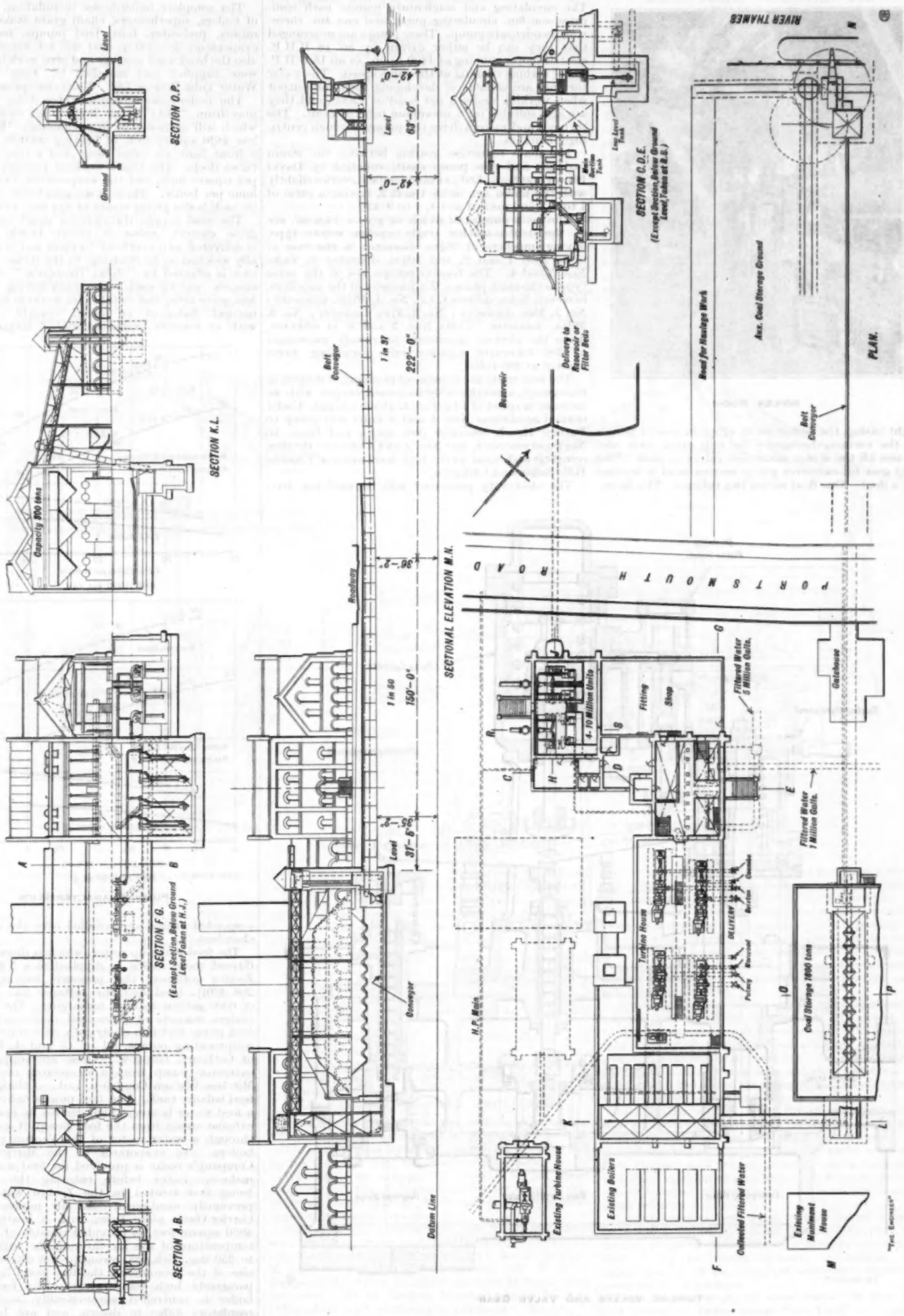



"THE ENGINEER"

MAIN PUMP—WORTHINGTON-SIMPSON

* No. I. appeared October 28th.

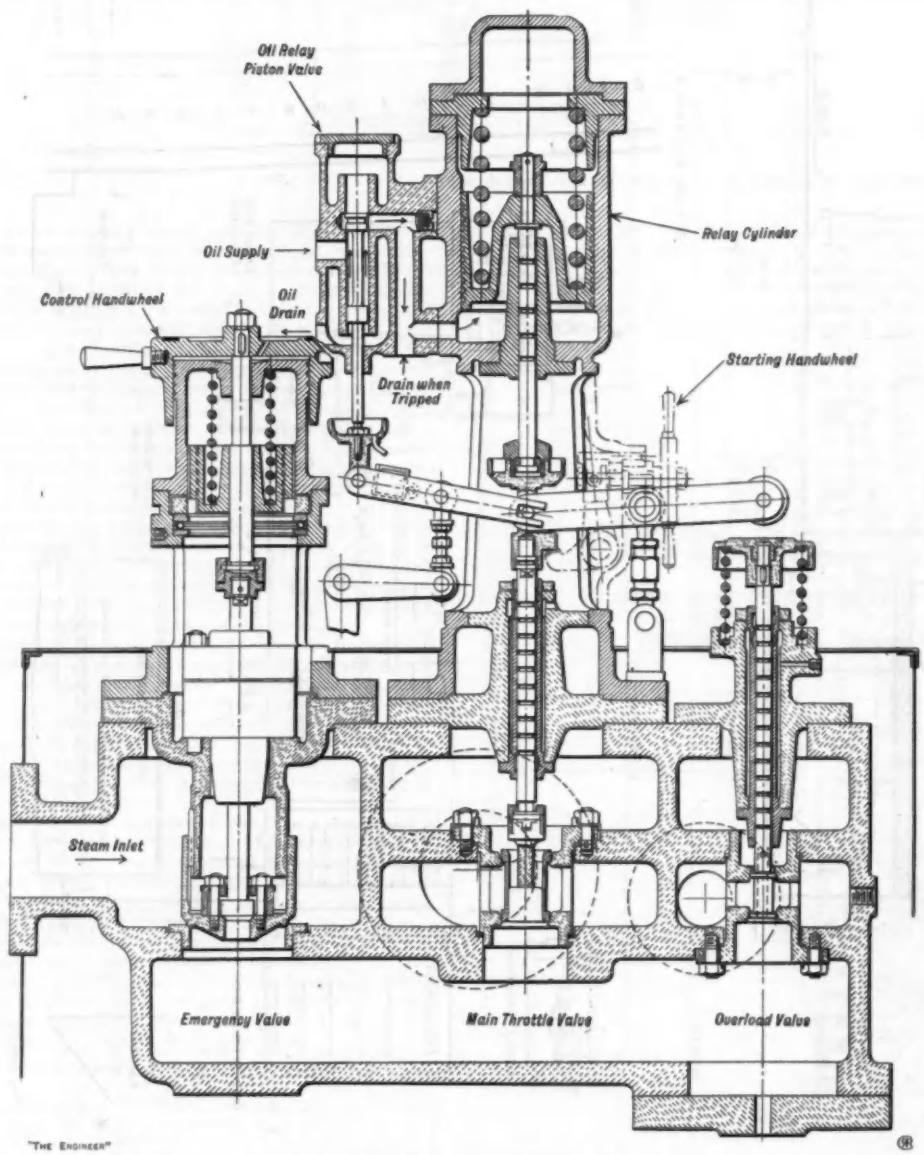
## SURBITON WATERWORKS—NEW PUMPING STATION



sive suction head of the pumps. The overspeed governor is attached to the end of the turbine shaft. It is of the excentric ring type, with the spring arranged co-axial with the centre line of the rotor. The vacuum trip consists of a diaphragm in an air-

BOILER ROOM

tight casing, the deflection of which in case of failure of the vacuum disengages the trip catch lever and causes all the steam admission valves to shut. The trip gear for excessive pump suction head is worked by a float. One float serves two tubines. The down-




TURBINE VALVES AND VALVE GEAR

wards movement of the float interrupts an oil circuit on each turbine, whereby oil pressure is built up in a small power cylinder which then disengages the trip catch lever.

The condensing plant consists of four cylindrical three-pass surface condensers, each having a cast iron shell with an exhaust opening 33in. diameter. There are four steam jet air ejectors, capable of maintaining a vacuum of 28in., and each provided with a combined tubular inter and after cooler. This plant is plainly shown in one of the engravings on page 458. The circulating and condensate pumps each comprise one 6in. circulating pump and one 4in. three-stage condensate pump. These pumps are so arranged that they can be either driven by an 18 B.H.P. electric motor running at 1400 r.p.m., or an 18 B.H.P. water turbine running at the same speed. The water turbines are capable of developing their full output when working under a net head of 130ft., and they are also suitable for a maximum head of 215ft. The turbines and motors drive the pumps through centrifugal clutches.

The main reduction gearing between the steam turbines and the pump shaft, supplied by David Brown and Sons, Ltd., of Huddersfield, varies slightly with the units, *i.e.*, units 1 and 2, having a ratio of 1 to 8·3 and units 3 and 4, 1 to 9·42.

The main pumps, of which we give a drawing, are of the double-suction single-impeller volute type. having impellers of 39⅛in. diameter in the case of units Nos. 1 and 2, and 40⅛in. diameter in units Nos. 3 and 4. The booster pumps are of the same type as the main pumps, the diameter of the impellers, however, being different, *i.e.*, No. 1, 35¼in. diameter; No. 2, 35in. diameter; No. 3, 37in. diameter; No. 4, 36½in. diameter. Units Nos. 3 and 4, in addition, drive the electric generators previously mentioned of 200 kilowatts capacity each supplying direct current at 200 volts.

The four units are capable of pumping, if desired in emergency, a considerably increased output with an increase in speed of 10 per cent. above normal. Under normal conditions Nos. 1 and 2 units will pump to Putney Heath reservoir (see map), and boost to Norwood reservoir, and Nos. 3 and 4 units to Brixton reservoir and boost to the high-level areas of Coombe Hill, Esher and Claygate.

The electricity generated will be used for driving auxiliary machinery and the pumps for raising the filtered water from the low-level filters into the suction culvert of the main units, the pumps for raising the unfiltered water from the low-level to the high-level reservoirs when required, and also for lighting.

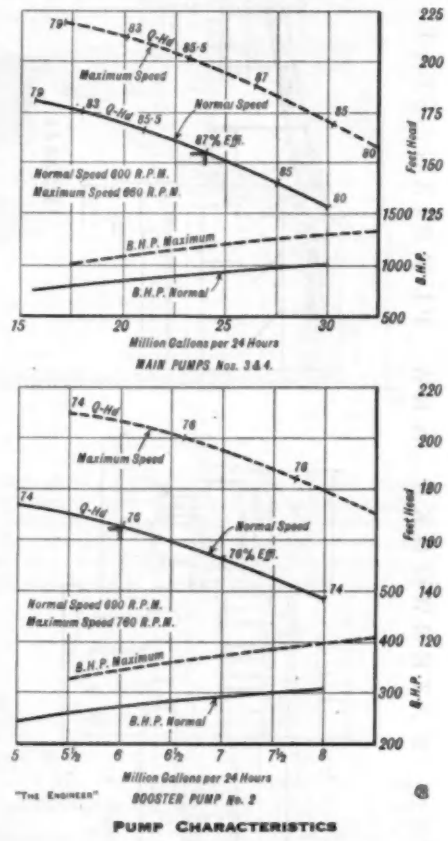
All these low-lift pumps are shown in our general arrangement, p. 453, but it must be borne in mind that they have not yet been installed and cannot be until the present beam engines have been dismantled.

### Boiler Installation.

The complete boiler-house installation, consisting of boilers, superheaters, chain grate stokers, economisers, preheater, fans, feed pumps, feed heater, evaporator, de-aerator, coal and ash-handling plant, also the brickwork settings and pipe work installation were supplied and installed by John Thompson Water Tube Boilers, Ltd., Wolverhampton.

The boiler-house contains three John Thompson four-drum "Beta" type boilers, set singly, two of which will normally be in commission. Each boiler has 4820 square feet, of heating surface. There is a front bank six tubes deep, and a rear bank nine tubes deep. The boiler working pressure is 250 lb. per square inch, and the evaporation 18,000 lb. per hour per boiler. There is an interbank superheater on each boiler giving steam at 625 deg. Fah.

The coal supply (bituminous small nuts with a gross calorific value of about 12,000 B.Th.U's) is delivered into overhead bunkers and is automatically weighed on its discharge to the stoker. Combustion is effected by "John Thompson" chain grate stokers—one for each boiler, each having 105 square feet grate area, and suitable for working under either natural, balanced or forced draught conditions, with or without preheated air. "Keystone" flat




PUMP CHARACTERISTICS

suspended arches are installed over the combustion chambers.

The feed make up water, which is drawn from the filtered water mains, is supplied to a "Kennicott" Zeolite softener, the pressure varying between 200–400ft. head and the softener has a capacity of 6000 gallons without recharging. The feed water system consists of a vertical double-acting steam feed pump and two electrically driven double-acting reciprocating pumps, all by G. and J. Weir, Ltd., of Cathcart, Glasgow. These are supplied by an extractor pump from a de-aerator made by the Mirrlees Watson Company, Ltd., of Glasgow, and a feed balance tank. The feed pumps deliver, through a feed water heater, which derives its heat from the exhaust steam from the feed pump, if working, and through a water meter of the Venturi type to the boilers. An evaporator of the Mirrlees Watson Company's make is provided for feed make up, the make-up water before entering the evaporator being first treated in the Zeolite water softener previously mentioned. An air preheater of the Carrier-Owen plate type, with a heating area of 4000 square feet, is provided capable of raising the temperature of the air entering the boiler furnaces to 250 deg. Fah., as, owing to the necessarily small size of the economiser, the flue gases have a comparatively high temperature. The feed to each boiler is controlled automatically, and the feed regulators differ in design, and are by separate makers—A. G. Mumford, Ltd., Ronald Trist and Co., Ltd., and Crosby Valve and Engineering Company, Ltd.—so that there will be an opportunity of making an interesting comparison.

In order to obtain the highest efficiency the plant

is provided with modern measuring and control instruments consisting of a Bailey metering system and duplex Mono $CO_2$ recorders, &c.

The boilers can be worked under natural draught or balanced draught with or without preheated air and two induced draught and one forced draught fans are provided for this purpose.

Plant is provided for dealing with the ashes from the three boiler furnaces and consists of water-sealed ash chutes from the backs of the stokers and separate water-sealed riddlings hoppers under the rear half of the stokers for discharging, continuously, the ashes, clinker and riddlings from the stokers on to an endless belt conveyor, which in turn discharges them into the boot of a bucket elevator. This elevator lifts them into an ash hopper above the ground level outside the boiler-house.

The five Lancashire boilers serving the existing steam turbine will be retained and fitted with mechanical stokers.

### Coal Handling.

The problem of handling the coal was complicated by the facts that the coal is delivered by barges and that the Portsmouth-road runs between the wharf and the boiler-house. It has, however, been solved in a satisfactory manner. The plant, capable of dealing with 25 tons of small coal per hour, has been designed to utilise the existing subway under the Portsmouth-road (through which originally the coal was transported by man-handled trucks), and the existing coal storage house is situated in close proximity to the boiler-house.

The main contractor for the whole of the plant was Robert Boby, Ltd., of Bury St. Edmunds. It consists of a 3½-ton electrically operated travelling jib crane on the river front, two endless belt conveyors, and a gravity bucket conveyor.

The coal is delivered alongside the river, where it is unloaded by the electric crane, operating a 1½-ton grab, into a receiving hopper situated over an endless belt conveyor, which conveys it through the subway under the road and delivers it on to a gravity bucket conveyor. This conveyor carries out the alternative duties of discharging the coal into the existing store house or on to another endless belt conveyor, which feeds the overhead coal bunkers in the boiler-house. The electric crane, by Thomas Smith and Sons (Rodley), Ltd., has lifting and slewing motions and derricking gear and a self-dumping grab. Separate electric motors are provided for all the motions.

The hopper on the wharf above the first belt conveyor has a capacity of 25 tons, and is fitted with an automatic weighing machine having a counter for automatically registering each weight and totalling the weight of coal passing on to the belt conveyor. This belt conveyor is 433ft. between centres, and consists of a four-ply rubber belt running on self-aligning ball-bearing idler pulleys. It passes through the subway to the coal store house, where the coal is either stored by the gravity bucket conveyor, or is dumped on to the second belt conveyor, which supplies the overhead bunkers in the boiler-house.

The gravity bucket conveyor is designed either to store the coal or draw from the stored coal heap to feed the belt conveyor to the boiler-house, or to feed on to this belt conveyor directly. It travels from the automatic rotary filler situated at the end of the first belt conveyor, upwards to the top of the coal store, goes along its length in which dumping gear is provided for discharging the coal at any point in the coal store, or into the chute which feeds the belt conveyor to the boiler-house. It then passes down the back end of the coal store into a horizontal tunnel under the heap of stored coal which can be fed into the conveyor when desired.

### Economies.

Considerable economies will be obtained by the bringing into use of the new machinery, as the average fuel consumption of the existing plant is 3·7 lb. per water horse-power per hour, whereas the estimated fuel consumption for the new machinery was 2·0 lb. per water horse-power per hour when the contracts were given out. On account, however, of the exceptionally low steam consumption guaranteed on trial by the contractors as follows :—

No. 1 unit, 10·48 per water horse-power per hour ;
No. 2 unit, 10·45 per water horse-power per hour ;
No. 3 unit, 10·21 per water and electrical horse-power per hour ;
No. 4 unit, 10·23 per water and electrical horse-power per hour ;
exclusive of auxiliaries—

the coal consumption under normal working conditions will probably be not more than 1·7 lb., or 0·16d. per water horse-power per hour. The capital charges will also be somewhat less than those estimated.

The average annual working expenses for the existing station (with coal at 25s. 5d. per ton) for the two years ended March 31st, 1932, were £55,636, and the estimated saving on that figure, after payment of the capital charges, amounts to about £4000 p.a.

The remodelling has been carried out under contracts with the following firms :—

*Engines.*—Worthington Simpson, Ltd., with steam turbines by the Fraser and Chalmers Engineering Works, cost approximately £48,980.

*Boilers.*—John Thompson (Wolverhampton) Water Tube Boilers, Ltd.; cost approximately £29,825.

*Coal-handling Plant.*—Robert Boby, Ltd.; cost approximately £7290.

*Alterations to Buildings, Construction of Culverts, Tunnels, &c.*—E. D. Winn and Co., Ltd.; cost approximately £68,988.

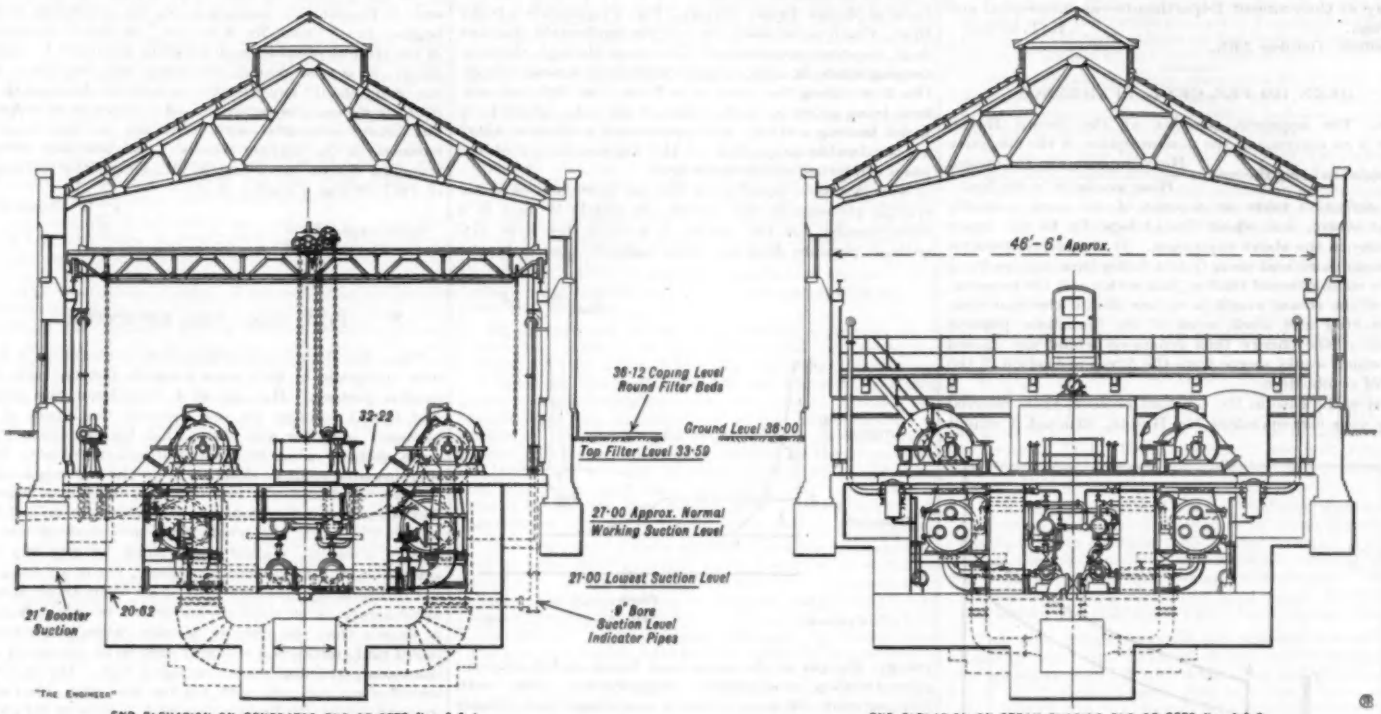
*Low-lift Pumps.*—Estimated cost £16,000.

The estimated cost of the remodelling scheme was £220,000, but the actual cost will be below this sum.

The station was formally opened on Tuesday last by Sir Hilton Young, the Minister of Health.

We desire to express our thanks to the Chief Engineer of the Metropolitan Water Board, Mr. Henry E. Stilgoe, C.B.E., M. Inst. C.E., for permission to publish this description.

The principal members of the chief engineer's staff who have been particularly identified with the construction of the new works are : Mr. S. Walker, M. Inst. C.E., deputy chief engineer ; Mr. F. E. F. Durham, M.I. Mech. E., chief mechanical engineering assistant ; Mr. G. Andrew Marshall, Assoc. M. Inst. C.E., chief civil engineering assistant ; Mr. A. J. Johnson, chief architectural assistant ; and Mr. W. A. Sellen, clerk of works.




END ELEVATION ON GENERATOR END OF SETS Nos. 3 & 4. END ELEVATION ON STEAM TURBINE END OF SETS Nos. 1 & 2.

**Cross Sections of Pump House**

## Letters to the Editor.

*(We do not hold ourselves responsible for the opinions of our correspondents.)*

### STEEL TRADE PROTECTION AND ORGANISATION.

Sir,—Uncertainty as regards the British tariff on steel and products has been cleared up—for two years at least—and the security, or protection, as measured by the 33·3 per cent. temporary tariff, has been stabilised ; but the question of organisation, or reorganisation, within the industry remains unsettled. It seems that Sir George May and his Tariff Advisory Committee, who have decided to prolong the Import Duty for two years, are not satisfied that the Steel Trade National Reorganisation Committee is making good progress with what is termed "rationalisation."

The temporary protection, now prolonged, has justified itself in so far as it has reduced "dumped" imports by one-half, notwithstanding the heavy reduction in the prices of Continental steel, semis and shapes, and to this extent has given the home producer an improved position in the home market. Incidentally, the tariff has not caused any advance in British steel prices, as predicted by its opponents ; but, of course, the ultimate effect of the new policy cannot be forecasted in these days of deep depression.

A water-tight monopoly of the home market might lead to monopoly prices ; something less than a water-tight monopoly—something merely to equalise competition and encourage home production, as designed by our tariff—may, by increasing output and reducing overhead charges per unit, and encouraging technical improvements, result in reduced prices, or, at any rate, in reduced costs. But what shall be said about organisation, or reorganisation, or rationalisation ? What has steel trade rationalisation done in Germany or America that we should carry it to extreme lengths ?

In Germany they have carried rationalisation to extreme degrees. With what result ? The object was to reduce costs. Costs have been increased. Dr. Reichert, chief manager of the German Iron and Steel Association, candidly confessed four years ago that rationalisation had failed in the German iron and steel industry. He stated that it had caused "a wrong investment of capital," and had led to "uneconomic costs."

As a matter of fact, when British steel prices had been got down to a level only 13 per cent. above the 1913 level, German steel prices were 28 per cent. higher.

Now that British steel prices are just about at pre-war level, German steel and products have to be bounty-fed by various subsidies ranging from 10 to 80 marks per ton, plus preferential railway rates, to enable them to compete in the international market.

The scheme of rationalisation, with its central management, has so far failed that the German Steel Trust has decided to modify the scheme by a decentralisation plan. The industry has become top-heavy, cumbersome, and uneconomic under the policy of centralised control of many works and products.

From America we get the same lesson. In 1900, the year before the United States Steel Trust was formed, cost of iron and steel production was low in America, and that country was second in steel exports. She was making such headway that it seemed she would soon take first place.

In 1901 the Billion Dollar Trust was established. It was declared that by bringing every phase of production and sale under a single central management, amalgamating ore and coal mines, steel works and engineering shops, ships, and even railways, under one control, great economies could be effected and prices so cut that the United States would "annex the world's steel export trade." Also, huge profits were to be made.

From the day, however, the mammoth Trust was organised, costs began to increase. Mining royalties on iron ore were jumped from 7 cents to as much as a dollar per ton of ore in the ground when the Trust set about the business of making sure of an ample supply of material for the future. Coal royalties were also increased.

State authorities devised new and special taxes to impose on the properties of the rich Trust. Directors and all staff men wanted huge salaries. Workmen demanded, and got, almost fabulous wages. Manufacturing costs were inflated, and by 1913 the United States had fallen to the third position in exports, besides which the tariffs had been increased to save the Trust from being beaten in its own market. Since the war, still under Trust management, the American steel industry has fallen to an insignificant fifth place as an exporter. It is not only beaten by Britain, Germany and France, but even by tiny Belgium.

To put it shortly, that sort of reorganisation—or rationalisation—which British coalowners and steel makers are advised to adopt, has completely failed in Germany and the United States. Mere bigness is not strength. Huge combines are apt to get as costly and clumsy as Government Departments—as impersonal and inhuman.

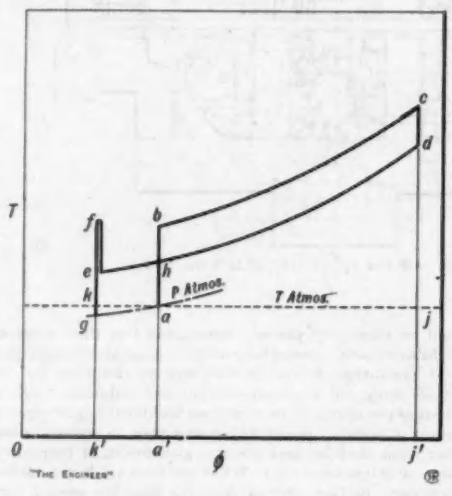
E. T. Good.

Sheffield, October 29th.

## OVER 100 PER CENT. EFFICIENCY.

Sir,—The apparent paradox of the Brown Boveri boiler is an outcome of the misconception of the efficiency of a boiler as being the ratio: $\frac{\text{Heat imparted to the steam.}}{\text{Heat available in the fuel.}}$ This definition takes no account of the work available in the steam, and which should logically be the upper quantity in the above expression. It is perfectly possible to obtain more heat units from a boiler than are produced by the combustion of the fuel, but in this case the temperature of the steam would be so low that if the heat were reconverted into work, even at the maximum possible efficiency, the energy thus generated would not exceed that which would accrue from the direct utilisation of the heat of combustion.

This is the case in the constant-pressure cycle referred to by your correspondent Mr. Hinton, although I cannot




agree with him entirely in his interpretation of the temperature-entropy diagram, which I reproduce here.

Assuming the specific heat at constant pressure to be independent of the temperature, and that the number of molecules of gas is unaffected by the combustion, then the temperature drop across the turbine must equal that across the compressor. For the sake of argument suppose that the conditions are so arranged that the heat delivered to the steam (assuming perfect heat transmission) equals that liberated during the combustion of the fuel. Then $T\,d - T\,e = T\,e - T\,b$; $T\,f = T\,b$, and the apparent increase in energy obtained over that generated by the burning fuel is given by the work which can be produced in expanding the gas from the condition at $k$ to that of the atmosphere. This last is most advantageously effected by an isothermal operation, the necessary heat being supplied by the atmosphere. We then have:

$$\text{area } b\,c\,j'\,a' = \text{area } e\,d\,j'\,k',$$
$$i.e., \text{ area } b\,c\,d\,h = \text{area } e\,h\,a'\,k'.$$

Now, the maximum amount of work which could be obtained were the steam to be heated regeneratively whilst the gases returned along the condition curve $c\,b$ is given by the area $b\,c\,j\,a$. The maximum amount of work possible using the Brown Boveri constant-pressure system is given by area $e\,d\,j\,k$ plus area $k\,a\,a'\,k'$, which equals area $b\,c\,j\,a$. Thus, there is the same energy available from this system as would be if the steam received its heat during the constant-pressure contraction $c\,b$.

If the conditions of this cycle were so adjusted that the energy remaining in the gas after the boiler stage was just sufficient to drive the compressor by virtue of its adiabatic expansion in a turbine, the net available work from the boiler would actually be less than the above, since, in this case, the work done by the exhaust gases whilst expanding to atmospheric pressure would be lost.

It is less easy to illustrate the explosion cycle on the temperature-entropy diagram, since all the gas does not undergo the same operations, but a similar reasoning will obviously apply. I am at a loss to see why, in this case, the operation undergone by the gas in the boiler should be at constant volume, when there is at all times direct communication with the atmosphere through the turbine.

F. Llewellyn Smith.

Oxford, October 27th.

Sir,—Mr. A. G. Hinton, in his letter published in your issue of the 14th inst., raises an important point in connection with the design of the Brown-Boveri Velox boilers, but he clouds the issue somewhat by discussing at length a theoretical cycle based on the assumption that the gases will encounter negligible resistance in passing through the boiler tubes at high velocity. Actually, the resistance so encountered is of paramount importance, and thus his argument, with regard to the various areas on his theoretical temperature-entropy diagram, is quite invalid for the actual practical case.

The real point at issue can be seen much more easily from considerations of pressure, volume, and kinetic energy.

Let us consider in this manner the "constant pressure" cycle of Messrs. Brown-Boveri. Fig. 1 represents a boiler tube. Combustion takes place in the combustion chamber A at constant pressure $p_1$. Gas flows through the converging nozzle B, and acquires considerable kinetic energy. Gas flows along the tube from B to C at high velocity, heat being given up to the walls of the tube, which form boiler heating surface. C D constitutes a diffuser, where a considerable proportion of the kinetic energy of the gas is converted into pressure head.

Now if it were possible for the gas to expand to atmospheric pressure in the convergent nozzle B, and if it were possible for the gas to flow along the tube B C without pressure drop and with negligible loss in kinetic

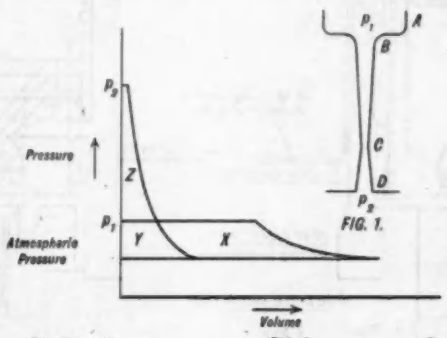



FIG. 1.

FIG. 2.

energy, the gas at the same time being cooled down to approximately atmospheric temperature, then with 100 per cent. efficiency of both compressor and diffuser we should have the remarkable fact that the energy available to drive the turbine would be about five times that required to drive the compressor, $p_2$ accordingly being many times greater than $p_1$. That this is so is clear from the pressure-volume diagram given in Fig. 2, where the area Y represents the work done by the compressor, where the area X+Y represents the kinetic energy gained by the gas in passing through the convergent nozzle B, and where the area Z+Y represents the change of kinetic energy into pressure head in the diffuser C D, the area Z+Y being equal to the area X+Y. Further, the ratio of the area X+Y to the area Y would be equal to the ratio of the mean absolute temperatures in the convergent nozzle B and in the compressor, that is, about 5 to 1.

However, the fact that the pressure drop in the tube B C is of paramount importance can at once be seen from the fact that for flow along B C at constant kinetic energy a pressure drop equal to the kinetic energy will occur in a length at most 150 times the mean bore of the tube. Further, the length of the tube required for a given drop in temperature of the gas will increase with higher velocities of flow in the tube. Hence there seems little reason to doubt Messrs. Brown-Boveri's implication that it is impossible to build a "constant pressure" cycle Velox boiler with the turbine at final exit from the boiler, so that 100 per cent. boiler efficiency is realised, and so that the turbine drives the compressor.

Mr. Corbitt has raised the possibility of a modified Brown-Boveri explosion cycle, in which the combustion chamber is charged at approximately atmospheric pressure. Certainly in this case the limitations on boiler efficiency, imposed by regenerative feed heating in the steam cycle, are less, and, in fact, would only be of much moment when there was a high percentage of moisture in the flue gases, and when it was practicable to condense this moisture out in the boiler.

However, I am doubtful if Mr. Corbitt's modified cycle would show any economic superiority over the original Brown-Boveri explosion cycle, when everything was taken into account.

A. H. Waring.

Norton-on-Tees, Co. Durham, October 25th.

## THE TREVITHICK CENTENARY.

Sir,—It is to be hoped, as Mr. Charles R. King remarks in his letter in your issue of the 21st inst., that additional light will be shed on Trevithick's rail locomotives as a result of the proposed centenary celebrations.

Mr. King himself, in fact, may be able to help in clearing up the following matter. In the *Railway Review* (the N.U.R. journal) dated April 10th, 1931, an article in his name was published on "The Birth Struggle of the Locomotive," and among the illustrations accompanying that article was a line drawing of a four-wheeled Trevithick engine bearing a general resemblance to the so-called "Catch-Me-Who-Can" locomotive of 1807–08. Under the sketch appeared these words: "Trevithick Locomotive, Reconstructed to Scale of Engine and Boiler found at Hereford Goods Yard in 1882, now in Science Museum, Kensington. Scale 1in. = 1ft. Standard Design from 1801. Feed-heater, Balance Weights, etc."

In the text of the article Mr. King stated that this engine (apparently minus the wheels) was found in a scrap heap in Hereford Goods Yard by Mr. F. W. Webb, of the L. and N.W. Railway.

The question arises: Was this drawing an authentic representation of one of Trevithick's rail locomotives? What did Mr. King mean by describing it as "Standard Design from 1801"? And, further, what ground had he for assuming that balance weights in the driving wheels were employed in such of Trevithick's rail locomotives as had, like the one shown in the sketch, an upright cylinder and a direct drive?

We know that, in the case both of Rowlandson's picture and of Trevithick's business card, the somewhat similar engine, the "Catch-Me-Who-Can," is there represented in the crudest possible, and therefore incomplete, manner. Hence, it is now doubly necessary and important that Mr. King should say whether or not the diagram in the *Railway Review* was authentic and accurate in all respects, but more especially with reference to the counterbalances in the driving wheels; also whether, being a standard design (according to Mr. King), the rail engine of 1807–08 was a replica of it.

F. W. Brewer.

Stevenage, Herts.,
October 31st.

## PITY ALSO THE INVENTOR.

Sir,—Mr. Walker's complaint that the inventor is often over-optimistic in his claims presents but one side of a painful picture. Has he ever considered the other? Not that I condone for one moment the lapses of the harassed patentee who states that his invention "will wash clothes" when he knows full well it will not. Such reprehensible conduct deserves from the righteous manufacturer or financier a full measure, indeed, of reproof. But what about the unhappy inventor who does decide to tell the truth, the whole truth and nothing but the truth; does Mr. Walker really think he gets any consideration, beyond a clear conscience, out of so doing?

Unfortunately, the inventor deals with those strange agglomerations of intellect known as boards. Now, it is known that the mildest of men, when promoted to board rank, develops a savagery only to be compared with the mass psychology of an outraged mob. The shivering inventor on the mat with his fortune gone, his family in want, his health broken, but with success in his pocket "for a' that," would, to any individual member of the board, be an object of encouragement even of mild admiration for what he has withstood; but not so to the board *en masse*. In their composite eye he is a thing obviously weakening, now is the time to smash him up, and take what he has as cheaply as possible. Therefore, keep him waiting a week or so. And so the unhappy inventor becomes in time inured to those cheery little epistles telling him that "the matter will have attention at our meeting next month," or "our Mr. Smith has left for his holidays and nothing can be done till his return."

With a long experience of board psychology it is often a matter of wonderment to me how business ever gets done at all in our larger and mostly top-heavy undertakings. But be that how it may, I would like to ask Mr. Walker to see that often the exaggeration of which he justly complains is the inventor's only defence against a system of "get him down" and "keep him down" that is only too often to-day apparent.

I would like to cite one case. I know of an invention on which the inventor had practically ruined himself. It was sound, it was promising, it was inspected and approved, and after much waiting he was invited to meet two members of the board, who made him a proposition. That proposition started by offering him exactly 0·01 of what he had himself spent in cash. Then, after the buyers had received so much, he was to receive so much more his total prospects at best offering him about 25 per cent. of his personal expenditure in perfecting his invention.

It is offers of this order that turn inventors' attention to lethal weapons, of course. But whilst I regret to say they are more frequent than Mr. Walker perhaps knows, I can assure him that there are distinctly two sides to the vexed question he raises.

Happy Jack.

October 30th.

[Readers will not fail to observe that our correspondent's letter supports Mr. Walker's contention that inventors are too prone to exaggerate. We find it difficult to believe that they do not do injury to their cause by that practice.—Ed. The E.]

## Railway and Road Matters.

In a written parliamentary reply, Mr. Pybus, Minister of Transport, states that he has made a regulation which requires that as from January 1st every vehicle when used as a passenger express carriage (that is, on a journey with a minimum fare of 1s.) shall be fitted with an efficient speedometer, so placed as to be easily read by the driver.

The Railway Returns for 1931 show a big decrease in the renewals, heavy and light repairs of locomotives, carriages, and wagons, when compared with the previous year. There were 380 locomotives, 1008 carriages, and 9398 wagons renewed as against 506, 1313, and 19,835 respectively in 1930. The number of locomotives under or awaiting repairs at the end of the year was reduced from 6·36 to 6·24 per cent.

In view of the railway companies' proposals to reduce further their men's wages, it may be noted that at the end of the forty-second week of the year the decreases in traffic of the four grouped companies, as compared with the corresponding period of last year, were :—Great Western, £2,103,000, or 9·61 per cent.; London, Midland and Scottish, £4,269,000, or 8·35 per cent.; London and North-Eastern, £3,924,000, or 10·34 per cent.; Southern, £1,502,000, or 8·96 per cent.

The proposals of the railway companies as to a further reduction in their men's pay came before the Central Wages Board on October 27th. As the representatives of the men opposed, a disagreement was recorded, and the companies' delegates intimated that they would take the matter to the National Wages Board. On the latter there are, as we have before remarked, in contrast to the Central Wages Board, four outside members—as "users of railways"—and an independent chairman.

There are many weaknesses in the case of those bodies which are opposed to the recommendations of the Salter Committee. One of their contentions is that the railway companies are themselves the owners of motor vehicles. That is so, but such vehicles are employed for the collection and delivery locally of goods and parcels traffic, and are in substitution of the horse-drawn vans and drays the companies have always used. Of the latter, they possessed 34,000 at the end of the year 1913, which was before the motor van era had made much progress.

The Dundalk, Newry and Greenore Railway was until 1873 a purely Irish concern. In that year, however, the London and North-Western took an interest in it in connection with the Holyhead and Greenore steamers, and built the Greenore Hotel. Eventually the line became a subsidiary of the L. and N.W. Company, with the Great Northern (of Ireland) having certain running powers. The working of the railway has, from November 1st, been transferred to the latter company, but evidently the £517,000 invested in the undertaking by the L. and N.W. remains with the London, Midland and Scottish Company.

At Sherborne, on the Southern Railway, there was a road level crossing accident on October 26th, of a kind that is hard to guard against. An up express train was due, and the level crossing gates were therefore closed against road traffic, and the signals put to "clear" for the express. A motor lorry was descending a hill towards the crossing at the time, and its driver's efforts to stop it in time were unsuccessful, and the road vehicle crashed through the gates into the path of the express. The driver of the motor vehicle was killed, and at the coroner's inquest a verdict of "Death by Misadventure" was returned.

One of the more serious accidents to railway servants which are mentioned in the railway accident blue-book for the three months ended on December 31st last related to a driver who had to turn his engine on an electrically operated turntable. The instructions for working the table laid down that for the class of locomotive to which this engine belonged the smoke-box must be at the end of the table where the motor was. That necessitated the table being turned empty, so the driver stepped on it and moved the control handle. The table moved in the opposite direction to that the man expected, and he was nipped between the control pedestal and the buffers of the engine. Whilst the accident is put down to the man's want of care, the report remarks that it is surprising that there is no indication whatever to show in which way the handle has to be moved, and as at times this might be a matter of importance, something in the way of a mark appears to be desirable for the guidance of those who are not altogether acquainted with the working of the appliance.

It was forty years, on November 2nd, since a serious railway accident occurred which aroused considerable public sympathy for the man at fault. It was what became known as the Thirsk disaster, and the scene was at Manor House signal-box, which is between Thirsk and Otterington, and under the supervision of the latter station. Signalman Holmes was due on duty at 6 p.m. on November 1st, but during the day his child was taken ill and he spent most of the afternoon walking from one village to another seeking the doctor. The child died, and he then was fully occupied in finding someone to keep his wife company. Holmes reported to the station-master that he was unfit for work, and that officer wired to York for relief, but the reply came that none could be sent. The only help the unfortunate man got was that his mate remained on duty until 8 p.m. Early in the morning Holmes accepted a coal train, but did not lower his signals for it. The man then fell asleep and was awakened by having the second portion of the up night express from Edinburgh offered to him. He saw that his block instruments had a train recorded, and, forgetting the coal train, he thought it was for the first portion of the express which he knew had passed. He therefore accepted the second portion, which ran into the coal train, and nine passengers and one servant were killed. Fire broke out from live coal from the engine, and not from gas, and six vehicles were destroyed. The driver of the coal train was considered somewhat to blame, as his train had been at a stand for seven minutes when the collision occurred. The relief arrangements and block working of the North-Eastern were criticised, and lock-and-block was recommended.

## Notes and Memoranda.

A good cutting oil for machining nickel-alloy steel consists, says *Machinery*, of a mixture of 8 to 10 per cent. of lard oil, 0·8 to 1 per cent. flour of sulphur, 10 to 20 per cent. kerosene, and the remainder mineral oil to give a viscosity of about 200. It is suitable for soft steels.

Cast phosphor-bronze bushings and rolled sheet-metal bushings, both having dovetailed grooves impregnated with graphite, but not lubricated with oil, have been tested in a fractional horse-power motor run at 17,500 r.p.m. continuously for 600 hours. At the end of this time, according to *Machinery*, the wear on the bushing, as well as on the shaft, was found to be negligible.

The first new mineral to be discovered by X-ray methods of investigation has been identified at the Natural History Museum, South Kensington, among a series of minute crystals presented by the firm of Potgietersrust Platinum, Ltd., from their workings in the Transvaal. Its principal constituents are platinum and palladium, and it has been named braggite, in honour of Sir William Bragg.

In the process of excavating the blue London clay in the basement of a London store, gelignite has been successfully employed as an explosive for loosening purposes. It has been found that with an overburden of not more than 3ft. the clay is thoroughly broken up, but is not thrown about. Neither are the surroundings disturbed. The charges used for this work were about ½ lb. per 3ft. hole.

Problems encountered in adding six storeys to a two-storey concrete building in Seattle that had no provision in the original design for increased loading are described in the *Engineering News-Record*. Four steel rods, 3½in. in diameter, placed around the old concrete columns, stiffened by welded lacing bars and finally encased in concrete, carry the load from the new floors around, and not into, the old columns.

For the fifth year in succession the Forestry Commissioners have had a survey made on the status of the elm disease (*Graphium ulmi*). First observed on the Continent in 1919 and in England in 1927, the disease is now common throughout western and northern Europe, and more recently its occurrence has been noted on a few trees so far away as Ohio in the United States. All kinds of elms ordinarily planted in England appear to be susceptible; but, judging from the investigations conducted in Holland, there is some foundation for the hope that completely resistant forms of the common species may yet become available.

As an outcome of the trend toward a greater use of insulating material in the construction of homes and offices, and in other fields, the Dominion Department of Mines at Ottawa foresees the establishment of a rock wool manufacturing industry in Canada. Should this materialise, the development of the large deposits of dolomite in the Niagara Peninsula of Ontario would follow, it is stated. Surveys conducted by the Department disclosed the presence of these self-fluxing, argillaceous deposits, and researches indicated their suitability as raw material for the manufacture of rock wool. At present the total requirements of the product are imported.

It is true, says *Nature*, that for a number of years individual firms have here and there made use of statistical theory in laying out efficient research programmes to improve the quality of production, or to establish sampling plans to reduce the cost of inspection; but there has been little contact between those interested on these lines. The practical worker has not fully realised the potentiality of the statistical tool, nor has he had any opportunity of discovering how similar problems have been dealt with in the research institutes or factories of other firms in the same field or in other industries. At the same time, the mathematical statistician has not understood the lines along which theory could be developed most helpfully.

Maintenance engineers regularly using calcium chloride for dust-laying on roads do not believe that it should be applied at any specific rate, but rather that it should depend upon the amount of traffic carried by the road. The following is a typical practice under general conditions :—100 to 200 vehicles per day, 1 lb. per square yard; 200 to 500 vehicles per day, 1½ lb. per square yard; 500 to 1000 vehicles per day, 2 lb. per square yard; 1000 and more vehicles per day, 2½ lb. per square yard. The best practice of applying calcium chloride is to make several applications. For example, should the road require 1½ lb. per square yard, it would be advisable to make one application of 1 lb. per square yard, and follow with a second application of ½ lb. six weeks later.

In a letter to *The Times*, Mr. I. M. Sieff, managing director of Marks and Spencer, Ltd., writing on reorganisation in the iron and steel industry, makes the suggestion that the National Committee has hitherto tackled the problem from the wrong angle of approach. Any grouping of producers, he holds, carries with it forces making for its own disruption; while, on the contrary, he suggests a grouping of marketing units carries with it forces of growth. The first step towards the reorganisation of the iron and steel industry, Mr. Sieff suggests, should be the formation of marketing groups for each main homogeneous finished product. These would be divided into two sections, home and export, and owing to the greater unity of interests in the export markets, this section, he considers, should be tackled first. There would in most cases, he thinks, be a sufficiently large nucleus of firms in the industry alive to the advantages of such a group, and it would only be a matter of time before such a group would pass into a marketing corporation controlling the entire sales of the industry. Fundamental reorganisations could be effected, it is suggested, in the producing section of the industry through such a marketing group, and the power which the marketing association would obtain would be one of several forces bringing producers together. Mr. Sieff writes with the concurrence of a small group which has been giving continuous study to problems relating to an improved organisation of industry, in the hope that the suggestions put forward will open up a new line of attack in the reorganisation of the iron and steel industry.

## Miscellanea.

Accidents in coal mines in the United States in 1930 resulted in 2063 fatalities and 103,821 cases of non-fatal injuries.

New seams of coal have been uncovered at Hamilton Palace Colliery, Rothwell, Lanark, and new haulage plant has been installed.

According to Mr. G. F. Sills, by the end of the year 1934 there will be 333,000 H.P. of hydro-electric plant in commission in Great Britain and Ireland.

The waters of the river Chirchik, in the Tashkent district of Russia, are said to be capable of the development of 1½ million kilowatts in the separate power stations.

Nine vessels of 24,616 gross tons represent the total output of Tyne shipyards for the first nine months of this year, against seventeen vessels and 112,988 tons last year.

Starting at the port of Strasbourg, the Rhine-Rhône Canal has been electrified as far as Mulhouse, with lateral canals to Colmar and Hueningen, near Bâsle, respectively, a total of about 90 miles.

A bulletin has just been issued by the U.S. Department of Commerce dealing in detail with the various methods of removal of soot from furnaces and flues by the use of salts or compounds.

Five new canning factories are shortly to be opened in different parts of the U.S.S.R., mainly for fruit and vegetables. They are being built and are to be operated by Soyusconserv, the tinned food trust.

The richest find of alluvial gold known to the present generation is the description given to a gold strike made by two out-of-work miners on the banks of the Kawarau River, in Central Otago, New Zealand.

American shipbuilding companies have been invited to tender for the construction of heavy cruiser No. 39. It is expected that the vessel will be laid down in January next for completion in thirty-six months.

The completion on October 15th of the excavation of a 3-mile tunnel from the river Spean to Loch Treig marked another stage in the realisation of the Lochaber water power scheme of the British Aluminium Company, Ltd. To date the company has spent £4,500,000 on the scheme.

The number of mines at work in Great Britain at June 30th, 1931, was 2243, compared with 2328 at June 30th, 1930, and the number using electricity was 1409, against 1439. The number of electric motors in use was 40,662, against 39,979, the aggregate horse-power being 1,833,536, against 1,816,464.

Having completed her return journey from Brazil to Friedrichshafen, carrying the record number of 40,000 letters, the German airship "Graf Zeppelin" left Friedrichshafen on October 24th on her ninth flight this year to Brazil. The "Graf Zeppelin" has now completed 310,700 miles, crossed the Atlantic thirty times and carried 7500 passengers.

It is the custom of the London Students' Section of the Institution of Electrical Engineers to invite a member of the Institution to open their winter session. This year Mr. R. Borlase Matthews addressed the opening meeting on Friday, October 28th, taking as his subject "What of the Future? with Electro-farming as an Illustration." The lecture was illustrated with cinematograph films.

The new bridge carrying the Missouri-Kansas-Texas Railway over the Missouri River at Boonville, Mo., includes a vertical lift span 408ft. long and weighing 1200 tons. It is claimed for it that it is the longest span of such description yet built. The superstructure of the bridge, which is 1638ft. long and weighs about 3700 tons, is stated to be remarkable for its extensive use of high-strength silicon steel.

Kyoto, a city with a population of 760,000, about 320 miles west of Tokyo, Japan, is building a sewage treatment plant in which activated sludge treatment and separate sludge digestion will be combined. The plant will be used to test out the efficacy of the activated sludge process on dye-house wastes mixed with domestic sewage, and will serve as the proving ground for the working out of a method of treatment to be used ultimately for handling the entire sewage of the city.

New large coal deposits are reported to have been discovered by Government prospectors in the Kabardine-Balkaria district of the Northern Caucasus. The deposits extend from the left bank of the Don River eastward to the Volga. They are very extensive—one section at Gukov is estimated to contain 1000 million tons of anthracite. There is also an undetermined amount of anthracite in the Nesvetayev and Grushev districts, and coking coal in the Gundorov and Belo-Kalitven districts.

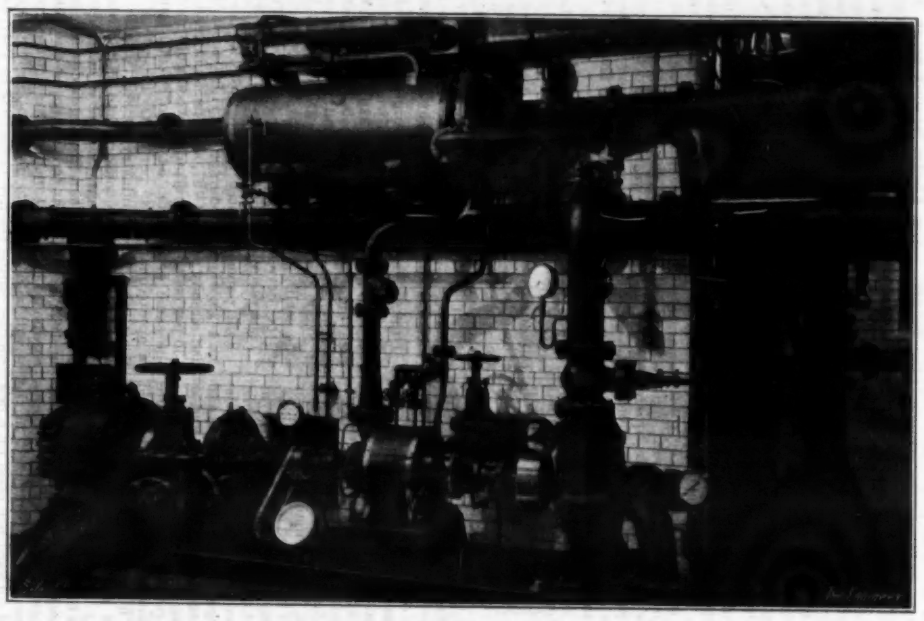
During the two months August–September the commercial fleet of the Black Sea was augmented by six new vessels of a total capacity of 32,000 tons. All the vessels were built in Soviet shipyards, and consist of two oil tankers, the "Mossoviet" and the "Soyuz Vodnikov," of 10,000 tons each, and four Diesel-engine ships of 3000 tons each. The "Nogin" and "Sklyansky" were built at the Sevastopol shipyards and the "Tsurupa" and "Timiryazev" at the Marty yards in Nicolayev.

The paper industry in the U.S.S.R. has grown since 1924–25, when it amounted to 211,000 tons, while in 1931 it had already reached 497,000 tons, an increase of more than 135 per cent. The output of wood pulp increased during the same period from 54,000 to 185,000 tons, an increase of approximately 245 per cent. In spite of this development, the paper industry is still unable to meet the requirements of the country, and on the whole it has not fulfilled what was laid down for it in the Five-Year Plan. The second Five-Year Plan provides for the production in 1937 of 2,000,000 tons of paper and 300,000 tons of cardboard. For the realisation of this production plan, it will be necessary to invest in the industry 2500 million roubles during the five years 1933 to 1937, and to put into operation 114 additional large machine units for the manufacture of paper and cardboard.

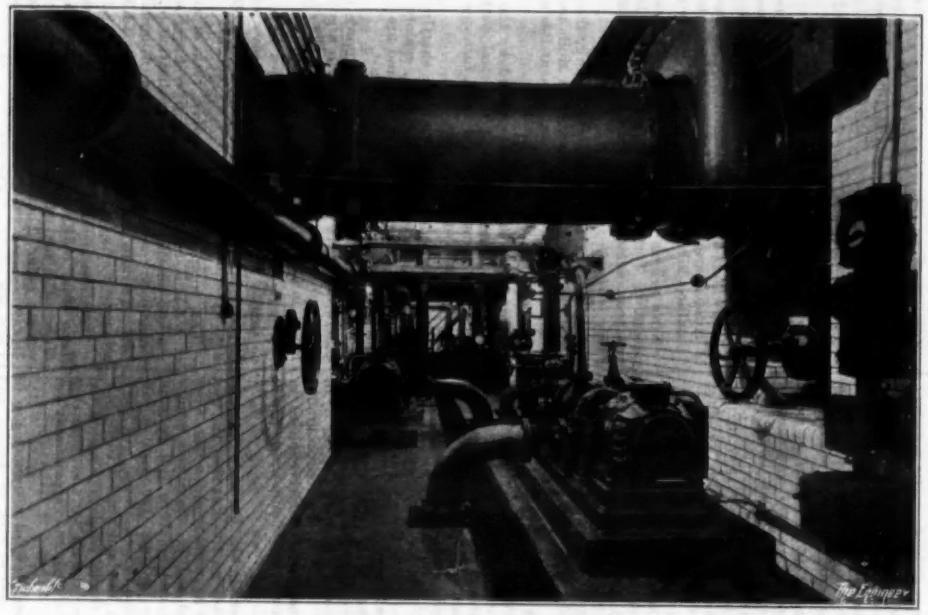
# SURBITON WATERWORKS—NEW PUMPING PLANT

MR. H. E. STILGOE, C.B.E., M. INST. C.E., ENGINEER

(*For description see page 452*).



CONDENSATE EXTRACTION PUMPS



CONDENSER BASEMENT AND PUMPS

CONVEYOR OVER BUNKERS

FEED END OF COAL CONVEYOR

# The Engineer

*NOVEMBER* 4, 1932.

VOL. CLIV. No. 4008


## Contents.


THE ENGINEER, November 4th, 1932. PAGE

A SEVEN-DAY JOURNAL .. 447
PRECISION GRINDING MACHINES. No. VII. (Illus.) .. 449
MECHANICAL ENGINEERING APPLIED TO THE MAKING OF LENSES. (Illus.) .. 450
THE SURBITON WATERWORKS. No. II. .. 452
LETTERS TO THE EDITOR—
Steel Trade Protection and Organisation .. 455
Over 100 Per Cent. Efficiency—The Trevithick Centenary—Pity also the Inventor .. 456
RAILWAY AND ROAD MATTERS—NOTES AND MEMORANDA—MISCELLANEA .. 457
LEADING ARTICLES—
More Majorum .. 459
33-kV Generators .. 459
EGYPT AND THE SUDAN .. 460
SIXTY YEARS AGO .. 461
LITERATURE .. 461
THE FRENCH LINER "NORMANDIE." (Illus.) .. 463
INTERNATIONAL ASSOCIATION FOR TESTING MATERIALS .. 464
NEW INSULATION TESTING SET. (Illus.) .. 464
AN IMPROVED RAILWAY POINT. (Illus.) .. 465
THE "REVOLVO" METER. (Illus.) .. 465
CANALS BECOME RAILWAYS .. 465
BRITISH STANDARDS INSTITUTION .. 465
THE WORK OF ANDREW LAING .. 465
PROVINCIAL LETTERS—
The Midlands and Staffordshire .. 467
Lancashire .. 467
Sheffield .. 468
North of England .. 468
Scotland .. 469
Wales and Adjoining Counties .. 469
PERSONAL AND BUSINESS ANNOUNCEMENTS .. 469
CONTRACTS .. 469
CATALOGUES .. 469
CURRENT PRICES FOR METALS AND FUELS .. 470
FRENCH ENGINEERING NOTES .. 471
BRITISH PATENT SPECIFICATIONS. (Illus.) .. 471
FORTHCOMING ENGAGEMENTS .. 472


### NOTICES TO READERS.

*** *If any Subscriber abroad should receive* THE ENGINEER *in an imperfect or mutilated condition, he will oblige by giving prompt information of the fact to the Publisher, with the name of the Agent through whom the paper is obtained. Such inconvenience, if suffered, can be remedied by obtaining the paper direct from this office.*

*** *For Subscription rates see page 2 of Advertisements.*

*** *All letters intended for insertion in* THE ENGINEER *or containing questions should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

*** *No undertaking can be given to return drawings or manuscripts; correspondents are therefore requested to keep copies.*

## MORE MAJORUM.

THE address which Mr. William Taylor delivered before the Institution of Mechanical Engineers on Friday last divided itself into two distinct parts; the first, a clear and practical description of the manufacture of photographic lenses; the second, a commentary on the sociological effects of mechanisation. The latter seemed to have been inspired by the now popular censure of mechanisation, as expressed by the Dean of Westminster in a speech at the Institution dinner a week before. But, whilst these two parts were different in kind and different in substance, there was an obvious connection between them. Indeed, since the descriptive lecture dwelt throughout upon the gradual replacement of the manual craft of lens making by mechanical processes, which enormously increased the rate of output, it is obvious that from the beginning Mr. Taylor was working up to a *finale* in which he vindicated mass production and the work of the mechanical engineer. It may seem strange that a President should have felt it necessary to defend his own profession before an audience of engineers and an Institution founded for, and devoted to, the prosecution of mechanical engineering progress. But it must be remembered, on the one hand, that it is always pleasant to hear from an exalted position the expression of views which the listener himself shares, and, on the other hand, that even amongst engineers there are some who doubt that the well-used arguments for mass production and mechanisation have retained their old validity. Whether those doubts were entirely dispersed by the *reductio ad absurdum* which Mr. Taylor employed, we shall not attempt to say. But it ought to be remembered by engineers more than by other people that extrapolation to infinity leads to conclusions which are not invariably trustworthy.

In the course of his address Mr. Taylor asked his audience to agree that as a counterbalance to their manifest evils wars frequently led to industrial developments which could be applied usefully in times of peace. No more striking example of the truth of that statement could be found than the advancement of the industry which Mr. Taylor adorns by the necessity of producing our own optical glass and lenses during the Great War. By well-conceived propaganda, Germany had succeeded in persuading the world that Nature had endowed her, and her alone, with the materials necessary for the production of the finest lenses. As a natural corollary to possession of the supply of the essential ingredients, she had brought her lens-making industry to a high pitch of perfection, and it may safely be said that up to 1915 this country was not only convinced that the best glass came from Jena, but depended, even for its military instruments, upon lenses made in Germany. Necessity forced this country to consider its position. It set up a research board, and, as everyone knows, that board found that the reliance upon Jena had been artificially cultivated, that all the requisites for making optical glass existed within our own shores, and that if proper encouragement were given to our manufacturers they could produce a glass as good as that of Germany, and lenses up to the high standard set by Continental makers. Old tradition and old beliefs die hard, and even now there are not lacking those who think no lenses are as good as those made by certain German firms, which made their reputation before the war, and therefore before England had developed her resources of material, skill, and knowledge. The position has completely changed, and it was satisfactory to hear from Mr. Taylor, whose experience cannot be challenged, that no better optical glasses than those now manufactured in England were obtainable in the whole world. If, in consideration of his connections, anyone hesitates to accept with equal confidence his statement that British lenses are superior to those of any other country, he has only to look at the remarkable results obtained by the products of Mr. Taylor's own firm to find himself compelled to admit that in beauty of execution and in inventiveness they have reached the zenith of perfection. Encouraged by such evidence, we readily accept his statement that "during the last twenty years nearly every single important advance in this field, nearly every step in providing faster lenses and better definition, has been made in England." But whilst the Institution of Mechanical Engineers was rejoiced to hear of the success achieved by glass manufacturers and lens makers, its interest lay in the development of mechanical processes in the production of lenses by the mass. When it is recalled that so great is the demand for cameras that orders for lenses are placed by the hundreds of thousands, it is seen at once that something very different from the old and slow methods was necessary. By admirably clear exposition and by numerous illustrations, Mr. Taylor showed to his deeply attentive audience how by the scientific study of the ancient hand processes mechanical means of producing the same actions were developed, or, as happened in several cases, it was found that what appeared to the traditional craftsmen to be necessary actions, were in fact, not essential at all, and could be omitted with a gain of simplicity and without depreciation of the result. As an example of the application of mechanical science, it would be difficult to find a more beautiful example than the utilisation of the cup grinding wheel for the production of a mathematically true spherical surface; whilst the ingenious research into the reason why if two flat discs are ground together with an orbital motion one will always be convex and the other concave, unless they are of proper relative diameters, or the finer research into the nature of cement pitch, which had long been a traditional craft secret, were as delightful as they were interesting. For the second of these researches, Mr. Taylor used the easily abraded Bath brick, whilst in the latter case it was found, after a Brinell test had been shown to provide the best means of determining the right consistency of the pitch, that the old workmen used also an indentation test—by biting the sample!

When it is remembered that the degree of accuracy of optical glasses exceeds by far that usually obtainable by the finest processes available to the workers of metals, and when it is observed that by almost purely mechanical means lens manufacturers have succeeded in reaching this accuracy under the conditions of mass production, it is impossible to withhold the highest admiration of the inventors and research workers who have made such an achievement possible. "One-thousandth of an inch" said Mr. Taylor, "is approximately the limit of accuracy which can be attained in the ordinary machining of metal with cutting tools. One ten-thousandth of an inch represents the order of accuracy generally attainable in such work by grinding and lapping. . . . But in making the best photographic lenses and other optical instruments of precision, the accuracy of the surfaces of the elements (such as lenses, prisms, and mirrors) must be from 0·00001 to a few millionths of an inch (measured in wave lengths of light); *and this accuracy is attained in every-day working, not only by skilled artist craftsmen of long experience, but by less skilled persons doing repetition work by the aid of special appliances, the products of mechanical engineering.*" We have italicised the last few lines of this quotation, because they embody one of the windmills against which reactionaries tilt. The view of these reactionaries is that by depriving men and women of the old methods of doing things, the *mores majorum*, they have reduced their measure of contentment, and have robbed the world of the joy of possessing things made by art. Do they not forget that the sum total of contentment is made infinitely greater by the processes which they condemn? It is impossible to estimate even roughly the number of those who derive pleasure from the possession of cameras. Perhaps not one of them reaches the full exaltation of the delight of the happy owner of a perfect lens in days when perfect lenses were rare, but in the satisfaction of a vast multitude the mechanical engineer, who has made the mass production of cameras possible, has far more than compensated for depriving the rare dilettante of his ecstacy.

### 33 kV Generators.

By the placing of the order for the two 30,000 kW 33 kV turbo-alternators for Swansea, a new impetus has been given to the practice of generating electricity at abnormal pressures. With the two 33–36 kV, 25,000 kW Parsons machines in operation at the Brimsdown station of the North Metropolitan Electric Supply Company, the 20,000 kW machine that is being built for the Salt River power station at Capetown, the 18,750 kW set for the South Wales Power Company, and the new Swansea alternators, there will shortly be six large Parsons machines operating at 33 kV or more. There is, therefore, every reason to suppose that engineers are beginning to realise that the risks of generating at high voltages are more imaginary than real. When 33 kV lines leave a power station direct generation at that pressure is attractive, for the whole sum representing the cost of the transformers which would otherwise be required, the cost of their housing and the capitalised value of the losses, less the additional cost of the high-voltage generator, can be saved. Any move that can be made to cut down power station equipment, and thereby save money, ought to receive careful attention, even if the scheme is not universally regarded as sound. The more we see of modern power stations the more we wonder what further complications will be introduced. Transformers are, of course, in many cases essential; in fact, it would be impossible to make very much electrical headway without them, but there is little sense in raising the pressure in a transformer when the desired voltage can be obtained direct from generator terminals.

Electrical men accustomed to designing alternators for 11,000 volts or less often claim that a relatively low voltage machine, combined with a step-up transformer, is safer and better than one wound for 33 kV. On the other hand, the increasing demand for these high-pressure generators is a clear indication that direct generation is steadily gaining favour. The capitalised value of the transformer losses represents a considerable part of the total capital outlay, and is said to be so much greater than the extra cost of the high-tension machine, that the saving of this expenditure is alone sufficient to justify generating high voltages. The various items on which there is a direct financial saving as the result of the use of high voltage generators are cables, transformers, transformer losses, buildings and, finally, switchgear which rapidly becomes more expensive when the current exceeds certain values. Transformer banks are, it is true, now usually erected in the open, but a certain expenditure is incurred in the provision of foundations and accessory structures. When one considers the remarkable strides that have been made in electrical engineering it is rather extraordinary that so little attention has been paid to the problem of raising the pressure of modern alternators. Cables have been made for 132 kV, and overhead lines, transformers, and circuit breakers for 220 kV, yet in many quarters a pressure of 11,000 volts or less appears to be regarded as the most desirable for alternators. The Ganz 30 kV, 5200 kVA, 450 r.p.m. machines, built in 1905, seem to have behaved quite satisfactorily, but for reasons which we need not discuss, such as the employment of higher transmission pressures, these machines have not been repeated in recent times. Nor have Continental

engineers paid any appreciable attention to the development of large high-voltage, 3000 r.p.m. steam-turbine-driven alternators. Manufacturers in this country who have not built 33 kV alternators are generally opposed to the idea. Every new move in the electrical industry has met with opposition from people unable, at once, to cope with it. When, for example, La Cour introduced his motor converter many refuted his claims, yet when the patents expired nearly all the large electrical manufacturers began to make it. Not very long ago anything said in favour of mercury arc rectifiers was liable to cause consternation among rotary converter makers, who seemed to imagine that by finding fault with the apparatus they could keep it off the market. But the rectifier had to come, and it is now being made in the workshops of some of the largest and most important British electrical firms. Similarly, in a few years time, 33 kV and, perhaps, considerably higher pressure alternators may become common. Among other disadvantages that some suppose these high-pressure machines to possess is the possibility of increased forces on the stator windings under short-circuit conditions, but Mr. J. Rosen has shown pretty conclusively that as a matter of fact the forces on the end connections of a high-voltage alternator are less than one-quarter of those on a 11,000-volt alternator of corresponding output. The figures were obtained on the assumption that the high-voltage alternator was short circuited directly across its terminals, whilst the short circuit on the low-voltage alternator was produced by connecting together the high-tension terminals of the transformer, thus including its reactance. Actual works tests and subsequent operating experiences are said to have confirmed the figures. High-voltage alternators have also been criticised from the point of view of harmonics, but here, again, C. A. Parsons and Co. claim that on this score every advantage lies with this type of alternator, which gives a voltage wave form free from ripples. Moreover, the harmonic currents present in the magnetising current of the usual step-up transformer are, of course, eliminated, and it therefore seems that direct generation should help to minimise harmonic difficulties rather than accentuate them.

A little investigation will readily show that in the matter of high-voltage generation this country is at present ahead of all others. The maximum generating pressure that has been reached in America appears to be 22 kV. Brown, Boveri and Co. have built a 36 kV, 31,250 kVA generator for the Langerbrugge power station in Belgium, but it does not, of course, incorporate the Parsons concentric conductor principle. Discussing 36 kV generators in a recent article appearing in *The Electrical World*, Mr. Paul R. Sidler, of Brown, Boveri and Co., New York City, explains that the conductor bars of the Langerbrugge machine are fully insulated to earth and protected against accidental disturbances of the potential distribution, caused, for instance, by steep front waves. To obtain an equally distributed insulation of sufficient strength, it was necessary to develop a new insulating material, as the existing mica preparations did not give satisfactory results. The machine was delivered to the Langerbrugge station in 1931, but what it has been doing in the meantime Mr. Sidler does not say. Whether Continental engineers are waiting for a report on the performance of the machine, or whether they have lost interest in high-pressure generation, we do not know; but, in any case, whilst on the Continent one of these high-voltage alternators has been built, this country will soon be able to boast of having produced six.

## Egypt and the Sudan.*

By Sir MURDOCH MACDONALD.

### Egypt.

The political Egypt over which its King rules is a territory covering a great area, roughly 360,000 square miles. The desert of which Egypt forms a part was at one time under the sea, and in it were deposited the various layers of sandstone and limestone rocks, of which the greater part of the surface of the country adjacent to the river is composed. After the uplifting of the region above sea level, the general slope was such that the drainage of a far distant interior region found an outlet into the Mediterranean, and gradually cut out for itself the channel in which the Nile now flows. It is within this eroded valley that the real or cultivable Egypt lies. This real Egypt is just about comparable in area with that part of England which lies south of the Thames.

In bygone ages there may have been real waterfalls on the Nile. To-day, however, they are no more than sufficient to cause very rapid flow when the river is in full flood, and make navigation difficult, though not actually impossible. Only one of these cataracts lies within the boundaries of Egypt—that at Aswan, called the First Cataract—the others are all in the Anglo-Egyptian Sudan.

The valley thus cut out by the river in Egypt and as far into the Sudan as Khartoum, a distance from the sea of about 1500 miles, is very narrow and in Egypt fairly deep, the escarpment on either side leading to a plateau 300ft. or 400ft. above the present bed of the river. The depth of silt and sand at Cairo is probably some hundreds of feet deep. This indicates that the river ran at a much lower level than it does now. It could only do that if the sea was also at a lower level. Consequently, there must have been a sinking of the whole country from the level at which it stood at one time, to account for the high level at which the river now stands in comparison with the level of the bed it formerly had.

An average silt deposit over the whole country of 10 cm. per century, *i.e.*, 1 mm. a year, is deduced from the records of water levels on the Roda gauge near Cairo, which have been taken for many hundreds of years. These indicate that the water levels have risen and the natural deduction is that the bed of the river and the general level of the cultivable land must have been raised also by that amount. It will be thus realised that what I call the real or cultivable Egypt is not geologically old; indeed, it appears to me to be about the newest country in the world. Other countries, such as our own, through rain and river action, are being worn down. Here is a country which is steadily accreting day by day, particularly in flood time, when the river pours sand and silt into the sea, pushing the coast line steadily though slowly outwards. The appearance of the projecting areas of land on either side of the existing branches indicates this, as they are, I understand, excrescences formed in quite modern times.

The level of the land must also be steadily but slowly rising. As a consequence, works like the barrages, founded on the silty bed of the river, will one day be found to be at too low a level; but as centuries must pass, according to such basis of estimation as has hitherto been at hand, before that happens I do not think it need worry the Irrigation Service much that the buildings they now maintain or are erecting will be unsuitable say 1000 years hence, if they manage to stand for that time.

Whatever the level which the Nile Plain stood at, early man saw that whilst the river overflowed its banks in its one annual flood season with marvellous regularity, both as to time of arrival of the crest of the flood and as to its height, there were minor irregularities in both these factors which caused him some little annoyance, the irregularities of height being much the more serious of the two. Once he had begun to cultivate, he would soon have realised that, if he was even partially to ensure any particular plot of land near his home against the worst of the irregularities in height of each flood, he would have to put an embankment around it, take water in at the upstream side, and thus to some extent ensure the lower part at least of his area having an adequate supply in the event of a low flood. He thus virtually turned his particular area into a basin. When early man did this he did a great thing. He took his first step in irrigation engineering.

Probably no other country in the world owes the possibility of carrying a human population more directly to engineering than Egypt, because, while the first requisite for cultivation, namely, the soil, in the valley of the Nile, may be said to be everywhere suitable, yet water, the second requisite, almost everywhere has to be artificially provided.

The necessity for drainage, the third requisite, in Egypt, depends to a large extent on the crops produced and the intensity of cultivation, and it is only within the last fifty or sixty years—and maybe even more particularly within the last thirty years—that the need for it has become strongly apparent.

To early man there would be no question of drainage. All he would be interested in would be to make certain that a sufficient depth of water stood on his fields for a reasonable period and thoroughly soaked the soil. The basin system of irrigation is still largely in use in Upper Egypt and has quite evidently lasted not only for centuries, but for milleniums. It is a wonderful system. Even the intentional destruction which might accompany the ravages of war could always be quickly repaired, and relatively little labour is required for the cultivation of the crops.

Very different is the position of the modern system, known as perennial irrigation. In this case intentional damage in war time could conceivably take years to overcome and repair. Under this perennial system, not only has water to be artificially provided, but drainage is also a necessity for which engineers have to make provision.

### The Delta Barrage.

The change which inaugurated the modern or perennial system of engineering works was the introduction of cotton cultivation by the great Khedive Mohammed Ali. As cotton is a summer crop, and as the Nile is low within its banks at that season, water in summer time could only be obtained by making extremely long canals, which would be of great depth near their heads, or lifting water up by shadoof, water wheel, Archimedean screw, or pumps.

The rise of the river in flood time above its summer level being something like 30ft., the difficulty of securing summer water for the higher reaches of the Delta will be apparent, especially when it is remembered that most of the canal heads must have had their beginning in the neighbourhood of Cairo or immediately north of it. The central portion of the Delta, for instance, could only be irrigated from a point below the bifurcation of the river about 16 miles north of Cairo.

The heavy lift to be overcome before water could be got out of these canals near their heads gave rise to the conception of a regulator right across both branches and near where they take their separate paths to the sea. With such a scheme in being every drop of water in the Nile in the low period could be diverted down the canals taking off in its vicinity upstream of it, and more important still maybe, at that time such water could be headed up to flow at a higher level and thus be made more easily available for the higher lands.

After years of consideration the series of works known as the Delta Barrage were constructed and completed in 1861. The structures consist of two barrages, one across each of the two branches of the river, and three head regulators for large canals feeding the main divisions of the Delta. The barrages were, however, unequal to the strain intended to be put upon them, for when the gates were lowered and the water gradually rose upstream they showed signs of failure, and they remained practically unused until after the British occupation in 1880. In the reorganisation of the affairs of the country which took place soon afterwards the problem of increasing the cotton area by providing a more adequate supply of water was again tackled.

That brilliant writer and explorer, Sir Samuel Baker, wrote to *The Times* in 1866, however, many years before, and suggested that if a dam were put across the head of the First Cataract of the Nile at Aswan, an enormous volume could be impounded and released when required for irrigation. I am glad to make this reference to Sir Samuel, as his daughter asked me years ago how it was that her father never received any credit for his brilliant conception. I could only say that until sometime before the lady spoke to me I was unaware myself of the true facts and I regretted if credit seemed to go elsewhere which rightly belonged to her father, as the originator of the idea; and I take this, the first, opportunity I have had of publicly dealing with the matter.

The head of the Public Works Administration in Egypt was that celebrated engineer, Sir Colin Scott-Moncrieff, and he ordered all the various projects suggested by people interested in the country to be examined. He deputed Mr. (afterwards Sir) William Willcocks to make the investigation and prepare all the designs and data for the various projects for submission to an International Commission. Mr. Willcocks pressed the Aswan proposal as being the best.

A Commission was appointed consisting of Sir Benjamin Baker, afterwards your own President, M. Boulé, an eminent French engineer, and M. Torricelli, an equally prominent Italian, Sir Benjamin Baker being chairman.

They, also, reported in favour of Aswan, and selected an alignment which they decided should be straight from bank to bank. The Government's original scheme envisaged the erection of a dam which would raise the water level of the river to 114·00 m. above sea level. As the river below the dam in summer time drops to about 86·00 m. above sea level, this meant impounding about 28 m. of water above low summer level, but eventually the level of the water to be impounded was restricted to 106·00 m. above sea level. The roadway of the structure was, however, put at the level of 109·00 m.

Hardly had the downstream protection works shown that there was a method of avoiding danger from the undermining of the structure than the necessity for further summer supplies became urgent. A scheme was devised whereby this demand could be met by thickening the dam and raising the roadway level to 114·00. This was submitted to Sir Benjamin Baker, who made it a practical proposition by his brilliant conception of a 6in. space, to separate the thickening from the older building and allow the new masonry to settle down into a temperature condition comparable with that of the older one, before the filling of the space with grout indissolubly bonded the two structures together. This work was completed in 1912.

Contemporaneously with the construction of the original Aswan Dam a barrage was built at Asyut, similar in intention, though not quite in design, to those existing at the head of the Delta. The idea was to allow summer water to flow into the Ibrahimia Canal, which takes off the river immediately upstream of the barrage, and permit in Middle Egypt of perennial, in contradistinction to basin, irrigation. It so happened that immediately after the construction of this work a phenomenally low flood occurred, and it became evident that the Ibrahimia Canal would not receive a sufficient volume of water to

* Institution of Civil Engineers. Presidential address, November 1st, 1932. Abstract.

irrigate all the land dependent upon it. Indeed, it appeared as if some 600,000 acres might lie fallow in that year. The late Sir Arthur Webb, then Under-Secretary of State for Public Works, decided to use the barrage for a purpose for which it had not been designed—that was, to head up the flood water. By the gallant efforts of Sir Arthur and Dr. Lowe-Brown, who was acting as Resident Engineer, the building was so protected downstream while this unintended head was being put upon it, that it safely withstood the strain. The highest praise is due to Sir Arthur for his action in this matter.

Year by year in low floods afterwards the barrage was used in a similar manner, and so successful was the whole operation in saving a vast area from famine that it was decided to construct at Esna another barrage, which Sir Arthur designed, to protect the basin lands lying to the north of it from similar vagaries of the Nile. A barrage designed by Sir Hanbury Brown was also erected on the Damietta Branch to enable both the summer and early flood supply to be better controlled in that region on either bank below it, and lastly and very recently, a similar structure to that at Asyut and Esna, but capable of carrying a much greater head, was erected at Nag Hamadi under the direction of Messrs. Coode, Wilson, Mitchell and Vaughan-Lee, and was opened in 1930.

### Heightening the Aswan Dam.

The cry for more and more water in summer time as cultivation extended northwards in the Delta made the Government a few years ago consider where further water could be obtained, and the possibility of still further heightening the Aswan Dam was considered.

At the request of Osman Pasha Moharrem, then Minister of Public Works, I prepared a scheme showing how this could be done. With other proposals, it was submitted to an International Commission composed of our own well-known Mr. W. J. E. Binnie, Mr. Gruner, an eminent Swiss engineer, and Colonel Cooper, a United States engineer of international fame.

The general principle adopted was to dress off the face of the existing dam and to put in downstream of it, in sliding contact, masonry buttresses which would so strengthen the dam that further heightening of the main structure could be carried out with safety, 7 m. more heightening being recommended. The Commission found that the dam as constructed was an extraordinarily well-built work, and as a consequence they said 9 m. might be added if desired, and while adopting the principle of sliding buttresses they made changes in the details, in particular they introduced a non-corrosive steel plate to assist the sliding principle. The Government approved of the suggestion to heighten by 9 m., and the scheme is in actual construction.

The Aswan Dam has fully justified its construction as forming a reservoir for irrigation water, and probably few public works in the world have given so enormous a return for the expenditure. This applied to the original dam, but it also applies to the thickened and heightened dam. No doubt it will apply to the reheightened dam now being constructed. There is, however, another justification for the reheightening, and that is that owing to the increased head it will be possible for the first time to utilise the dam for hydro-electric purposes in an economical manner.

A glance at the figures of storage will probably illustrate, better than anything else that could be said, the benefit to Egypt of the Aswan Dam. The original reservoir stored about 1000 million cubic metres of water, which augmented the normal summer flow by very roughly 12½ per cent.; the heightened or present dam impounds 2400 million cubic metres, the normal river flow now being increased by some 33 per cent. The dam now being constructed will impound at least 4800 million cubic metres and increase the normal summer supply by, say, 66 per cent.

### Other Projects.

The Gebel Aulia reservoir as at present contemplated will contain about 3000 million cubic metres and will possibly be able to pass 2500 million into the river to augment its supply, the remainder being lost in evaporation over the large surface area.

On the other hand, a Lake Albert Dam only 8 m. in height would impound about 40,000 million cubic metres. It is not suggested that all this volume could be reserved each year from each flood; but, of course, if the reservoir was full, as much of it as was required could be let out in one season to prevent an abnormal deficiency, and in this case dependence would have to be put on the improbability of two abnormal years occurring together. Quite obviously greater control for the advantage of Egypt can be obtained by damming Lake Albert than can be secured at any other point to the north, but such control must be coupled with works which will conserve the waters as they pass down the river and prevent them from being wasted as at present in the Sudd region.

It is known, through the intensive examination of the *régime* of the river in these far southern reaches, that a considerable volume of water comes in from the smaller rivers branching into the Nile south of Gondokoro and north of Lake Albert. It may therefore well be that a dam should be erected at Nimule—where there is a rocky gorge which conceivably would permit of the easy construction of such a work—and there the waters of these rivers would be retained in the reservoir so formed.

At any rate, it is obvious that vast quantities of water, compared with which even the large volume of the new Aswan Reservoir is inconsiderable, are available in the upper reaches of the White Nile.

South of the point near Esna referred to, the land must be commanded by pumping plants erected on the river, where such plants are not already in existence. These plants, it is to be hoped, will ultimately be driven by electricity generated at the Aswan Dam.

The total area cultivated and fully protected in Upper Egypt will then be about 2,250,000 acres.

An unexpected development in Upper Egypt is the combination of Basin with Perennial Irrigation, the water for the latter being found by pumping water from the sub-soil. There are advantages attached to this system which may make the Public Works Ministry decide to go slowly with the conversion of these basins to purely perennial irrigation. Under the latter system a water supply has to be carried from the river in canals from which branches diverge and from which smaller canals and outlets lead the water into the smallest field channels; but such a system cannot operate together with a basin system. Individual owners lifting water from the sub-soil can, however, combine a form of perennial operation with basin irrigation.

In Lower Egypt there is now due a reconsideration of the Delta Barrage structures, which, although strengthened and improved with weirs, might be made still more effective. There seems to be no necessity to remove the existing structures and build new ones. The alterations necessary are not great, and could be met in the principal item by an additional weir downstream of the Rosetta Branch barrage.

### The Sudan.

After describing the Sudan and the course of the Nile and its tributaries above Wady Halfa, the President touched upon the schemes put forward for preventing the immense loss of water due to evaporation from the marsh formed by the main stream between the Sobat and Behr-el-Ghazal rivers. The whole territory, including the marsh region, had an area of about 90,000 square miles, and might become a wonderful timber country supplying all the wants of Egypt and the Northern Sudan.

He next described the developments of the Gezira region of the Sudan by the construction of the Sennar Dam, following the discovery that cotton could be sown there in July and picked in February or March, thus requiring for its cultivation only water which otherwise would be wasted in the Mediterranean.

From the Sennar Reservoir it had been found possible to irrigate about 460,000 acres without taking any of the natural supply of the river during the period when Egypt required all that passed. As to further development of the Gezira, if insurmountable difficulties should arise to preclude the utilisation of Lake Tsana, the Sudan could conceivably erect another barrage at Roseires, which would allow about another 500,000 acres to be cultivated in the Gezira—sufficient for a good many years to come.

It might also be worth while some day to build pumping plants on the Nile and deliver water to the large area of land between Sennar and Roseires standing at a high level above the reservoir; in which case as a grain-growing and cattle-raising country it might conceivably become very valuable.

Summing up the position between Egypt and the Anglo-Egyptian Sudan as regarded the possibilities of development from the Nile, the President remarked that Egypt had had from the very dawn of history a claim on the waters of the Nile. The large volumes passing in flood, however, of which Egypt could only use a small part, made it possible for the Sudan to use a great quantity of flood water without detriment to Egypt, except in so far as the height of the flood was concerned. To-day that was not an important factor, the construction of all the barrages having made it easy to give height artificially. In future the flood volume might be diminished by such structures as the Lake Tsana Dam for the use of the Sudan, and the White Nile Dam and the Lake Albert and Nimule Dams for Egypt. All the conceivable diminution by those reservoirs, however, would not be sufficient to reduce the flood volume below all known requirements of Egypt for the fertilisation of her flood crops.

The Sudan could cultivate further lands in the flood season; but even then a time might come when she would have to call a halt to the process, in the interests of Egypt. The Sudan could not, however, without building additional reservoirs, develop any further land with summer water, because Egypt now took it all.

## SIXTY YEARS AGO.

From our issue of November 8th, 1872, various items of information having a naval or military interest are to be gleaned. The Admiralty, we learn, had at length decided to dismantle the "Bulwark" an unarmoured, wooden, two-deck, 91-gun line-of-battleship, which had been laid down at Chatham Dockyard in 1859. She was still encumbering one of the building slips, for she had become entirely obsolete. Her timbers, it was stated, would be used in some armour-clad vessels which were to be built at the dockyard. . . . There was much discussion at the time concerning the ability of projectiles to penetrate the newest types of armour. Trials made at Shoeburyness had, in the opinion of many people, demonstrated that the armour could readily be pierced. Captain Sherard Osborn was, however, of a different opinion, and in the issue quoted he gave a curious practical illustration which seemed to support his view. He argued that while the penetrating power of a projectile might be very great, the ease with which it could be deflected from its path deprived it of much of its possible effect. The incident which he related occurred on the "Monarch." One day at exercise a 600 lb. shot was fired by accident from one of her 25-ton guns. The projectile was discharged straight along the ship's deck in a direction in which the ship's master, Captain Aynsley, and eight men were standing. They would inevitably have been swept away but for the fact that the shot touched its shoulder against a small iron bar about 2in. in diameter. The bar was bent, but the shot was deflected by it over the ship's side. . . . The "Devastation," our first mastless sea-going turret ship, had, as mentioned in this note a fortnight ago, suffered mishap on her first trials. Her two sets of engines had broken down within a quarter of an hour of each other, as a result of the failure of the circulating pumps, a coincidence which seemed to confound the advocates of twin-screw installations, but which fulfilled completely certain prognostications made in our own columns. The defects were duly repaired, and on October 31st, 1872, the ship left Spithead for the measured mile in Stokes Bay. The trial results, we recorded, were in all respects satisfactory. Under full boiler power the mean speed over six runs was 13·839 knots, or fully ¼ knot in excess of what had been anticipated. At half boiler power the mean speed over four runs was 11·909 knots. The six hours' run had yet to be made, and we expressed the opinion that the results of that trial would be awaited with anxiety. . . . A fourth item of warlike interest concerned the Mauser rifle, the new weapon selected by the Prussian Government for the arming of its troops. A large contract for the manufacture of these weapons had been placed with the National Small Arms Company, of Birmingham, but the conditions of secrecy imposed on the producers had hitherto prevented much information concerning the design of the rifle from reaching the public. It was, however, impossible, so we wrote, to keep the secret for long. By some means or other we had obtained a description of the rifle and sectional drawings showing the breech action. Our engravings show that the rifle, as first produced, was not of the magazine type, but fired cartridges which were loaded singly. The empty cartridge case was automatically ejected when the breech was opened for reloading.

## Literature.

### SHORT NOTICES.

*The Strength of Materials.*—Second Edition. By J. Case, M.A. London: Edward Arnold and Co. Price 30s. net.—This book does not cover the full field of stress calculation, and the author's preface to the first edition well defines its aims:—"In all books on stress calculation, save the very elementary, the discussions of the earlier parts of the subject seem to be inadequate to the needs of the student who meets it for the first time. On the other hand, a book which deals fully with the elementary principles probably does not go sufficiently far for the student who is reading for an honours degree. My object here has been to produce a book with which the honours candidate can begin and complete his studies." The first edition proved so successful in its purpose that, save for the addition of a few examples and footnotes and a slight alteration in the chapter on bending moments, no change has been made in this, the second edition.

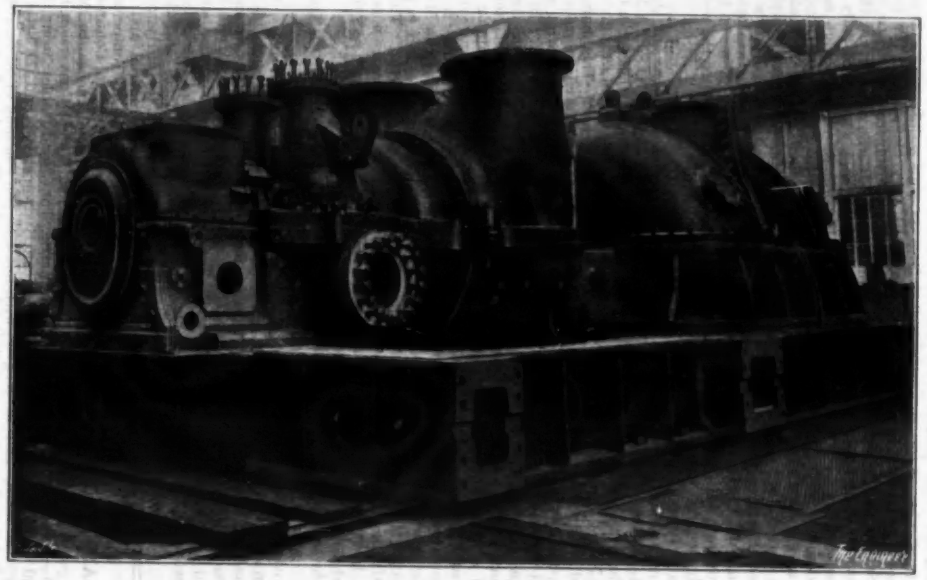
*Civil Engineering Specifications and Quantities.* Second Edition. By G. S. Coleman, D.Sc., A.M. Inst. C.E., and G. M. Flood, B.Sc., A.M. Inst. M. & Cy. E. London: Longmans, Green and Co., Ltd., 39, Paternoster-row, E.C.4. Price 12s. 6d. net.—The main purpose of this book is to instruct young civil engineers in the essential features to be considered in preparing specifications and quantities for constructional work. In the new volume certain printing errors have been corrected, and the descriptions of some of the materials and tests have been brought up to date. Sections containing British Standards Institution specifications have been revised, and two new chapters added, one on the procedure to be adopted when schemes are to be submitted to the Ministry of Health, the other on parliamentary procedure in promoting private Bills of an engineering character. The book maintains the interesting and comprehensive character of its predecessor, and will, we are sure, be as valuable to its users.

*Tunnard's Tanker Tables: A Handbook on Petroleum Metrology.* By B. Tunnard. Glasgow: Brown, Son and Ferguson, Ltd. Price 7s. 6d. net.—Much uncertainty exists in the petroleum industry of this country as to the correct method of converting volumes to weights, and *vice versâ*, and this little volume will be found of great assistance to all connected with the handling and storing of oil. It gives the essential particulars connected with the Calibration Scale, Ullages and Soundings, Hydrometers, Hydrometer Scales, Use of Hydrometers, Sampling, Standard Temperature, Imperial and American Gallon, Metric Measures, Effects of Temperature, Coefficients, Methods of Calculating a Cargo, Contents of Pipes. There then follow:—Feet and Inches to Metres Conversion Tables, Volume to Weight Conversion Factors for British and Metric Tons, and tables using both British and American Hydrometers; and the little volume concludes with notes on the handling of oil cargoes and the carriage of heavier oils. The tables first appeared in 1928, and should prove of great assistance on all "tankers."

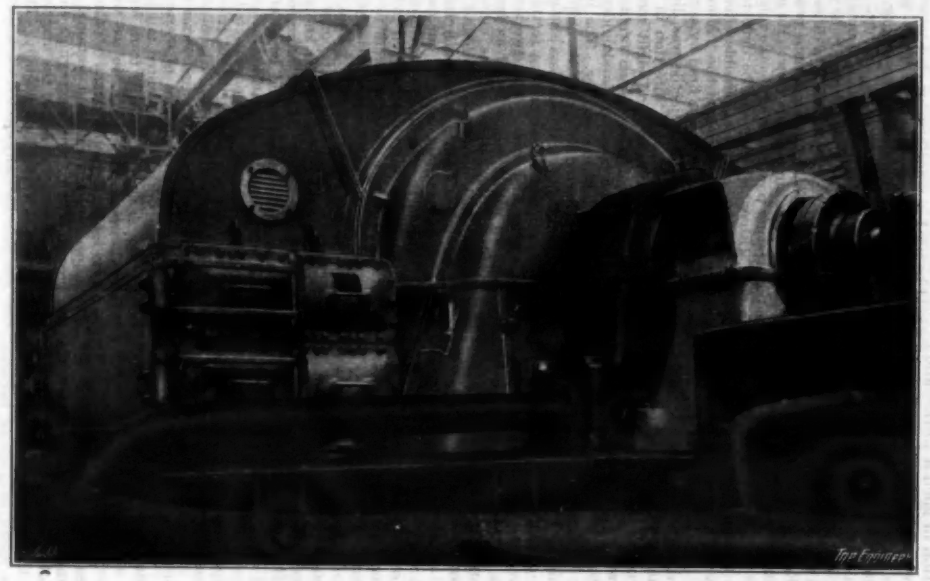
# THE NORMANDIE; TURBINE-DRIVEN ALTERNATORS AND MAIN PROPELLING MOTORS

SOCIETE GENERALE DES CONSTRUCTIONS ELECTRIQUES AND MECANIQUES (ALSTHOM) BELFORT, ENGINEERS

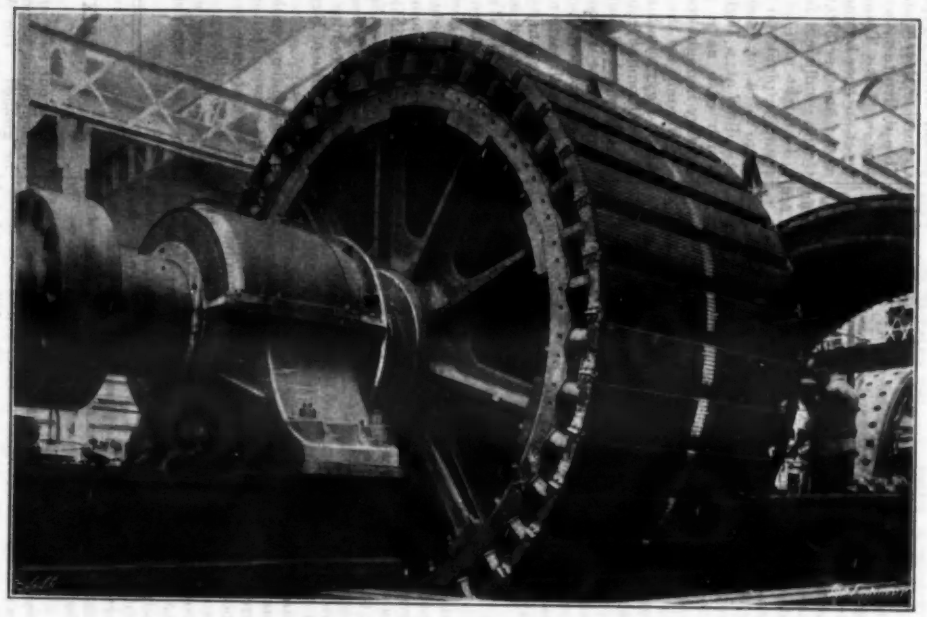
(*For description see opposite page.*)



ONE OF THE FOUR MAIN TURBINES



ONE OF THE FOUR 34,200 kW. ALTERNATORS



ROTOR OF MAIN PROPELLING MOTOR

ONE OF THE FOUR 40,000 H.P. PROPELLING MOTORS

## THE NORMANDIE ON THE STOCKS, BOW AND STERN VIEWS

## The French Liner Normandie.

By the courtesy of the French Line we were invited to be present on the afternoon of Saturday last, October 29th, at the Penhoët shipyard, St. Nazaire, for the launching ceremony of the new Compagnie Générale Transatlantique Atlantic liner, a 30-knot ship larger by nearly 20,000 gross tons than any other liner afloat. Precisely at 2.50 p.m., or several minutes before the official time fixed for the launch, the "T 6" was named the "Normandie" by Madame Lebrun, wife of the President of the French Republic, and the giant hull began gently to move down the two broad launching ways. Within a couple of minutes she was waterborne, and was then slowly manœuvred by a number of tugs away from the scene of her launch to an entrance lock, which has a length of 1200ft., a width of 168ft., and a depth of 45ft., and has been specially built by the Chamber of Commerce of St. Nazaire to serve as a dry dock. Later, we were given to understand, she will be moored in the company's fitting-out basin, where her sister, the "Ile-de-France," is at the present time undergoing overhaul.

It may be recalled that it is almost exactly two years since, in reply to foreign competition, the order for a 75,000-ton, turbo-electrically propelled liner was placed by the Compagnie Générale Transatlantique with the Société des Chantier et Ateliers de Saint-Nazaire (Penhoët). The first keel plate was laid on January 26th, 1931, and it is expected that the ship will be ready for service early in 1934. The "Normandie" will mark without doubt, alike in her hull construction, her modern passenger accommodation, and the size of her propelling machinery an outstanding forward step in the design of the large Atlantic liners, and the following technical particulars concerning her, all that are at present available, will be of interest to our readers :—

*Hull Particulars.*

| | |
|---|---|
| Length overall | 1027ft. |
| Length between perpendiculars | 963ft. |
| Beam at main deck | 117ft. 9in. |
| Beam at corbelled promenade deck | 119ft. 6in. |
| Depth, moulded, to promenade deck | 91ft. 4in. |
| Height from keel to top of chart room | 128ft. |
| Loaded draught | 36ft. 7in. |
| Loaded displacement | 67,500 tons |
| Deadweight carrying capacity | 12,000 tons |
| Capacity of fuel bunkers (deep-tanks, double-bottom and transfer tanks) | 338,980 cu. ft. |
| Capacity of holds and 'tweendecks for cargo | 123,295 cu. ft. |
| Capacity of water ballast tanks | 258,356 cu. ft. |
| Approximate gross register | 75,000 tons |

*Passenger Accommodation.*

| | |
|---|---|
| First-class passengers | 930 |
| Tourist-class passengers | 680 |
| Third-class passengers | 560 |
| Officers and crew | 1320 |
| Total number of persons carried | 3490 |

*Propelling Machinery.*

| | |
|---|---|
| Type | Quadruple-screw, turbo-electric |
| Number of turbo-alternator sets | Four |
| Type and voltage | Three-phase, 5500 to 6000 volts |
| Designed output, each set | 34,200 kW |
| Normal running speed | 2430 r.p.m. |
| Number of propelling motors | Four |
| Type and voltage | Synchronous, 5500 to 6000 volts |
| Designed output, each motor | 40,000 S.H.P. |
| Running speed | 238 to 248 r.p.m. |
| Total propelling power | 160,000 S.H.P. |
| Sea speed of ship | 30 knots |

*Boiler Installation.*

| | |
|---|---|
| Number of main boilers | 29 |
| Type : Water-tube, oil-fired, with superheater and air heater | |
| Working pressure | 400 lb. per sq. in. |
| Total steam temperature : 350 deg. Cent., or 662 deg. Fah. | |

*Auxiliary Geared Turbo-generator Sets.*

| | |
|---|---|
| Number of sets | Six |
| Designed output, each set | 2200 kW |
| Turbine speed | 5300 |
| Generator speed | 530 |
| Voltage | 220 |
| Total ampères, capacity | 60,000 |

From the photographs reproduced above and below, some idea will be gained of the appearance of the ship. We were privileged to inspect her on the stocks shortly before she was launched, and to see her both in the water and in dock, and were impressed with her good proportions and well-designed lines, which gave the impression of a really handsome ship of not undue length or size. When we say that the hull is longer than the Haymarket and much wider than that street, the significance of this statement will be apparent.

### Hull Construction.

In the construction of the hull over 5000 tons of high tensile steel, with a breaking strength of 40 tons per square inch, compared with the more usual 30 ton steel, has been employed, principally in the outer plating of the double bottom and the upper decks, while electric welding has, where desirable, been used, mostly for internal structural fastenings. Some of the principal weights are of interest. The

THE HULL ENTERING THE WATER

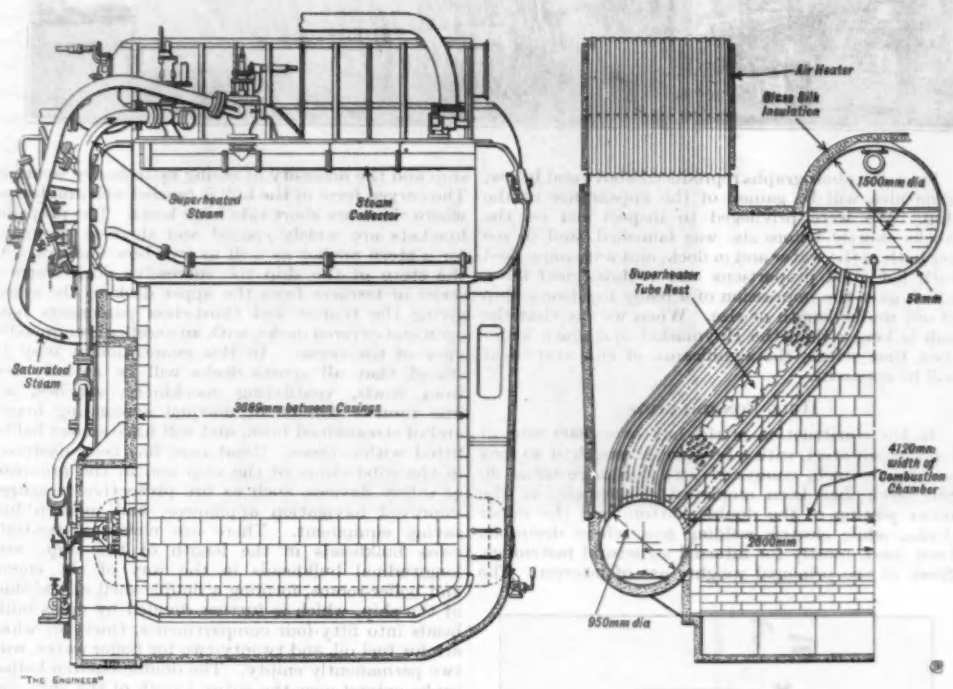
two-piece stern post weighs 100 tons, the rudder post and its rudder 125 tons, and each of the four propeller brackets 50 tons. The total weight of the hull at launching was over 30,000 tons, quite a record figure. In order to decide the lines of the ship more than sixty tank models were tested, including many different forms at varying draughts. We understand that in the design finally adopted the Yourkevitch form was used. It is a new form of low-resistance hull, giving, we understand, considerable economy in propulsive power. We found this form, with its pleasing curves, of more than unusual interest. The clipper-like bow, with its slightly bulbous fore-foot, is widely flared at the sides towards the top, and is surmounted by a completely covered forecastle deck of whale-back form, which is carried back right up to the front of the wide bridge, with its curved front and strut-supported wings. The object of this covered forecastle deck is to deflect any water which may fall upon it back again into the sea, thereby avoiding possible damage to the ship and the necessity of easing up in heavy weather. The curved form of the hull is carried well amidships, where there are short side bilge keels. The propeller brackets are widely spaced and there is provision for a stern anchor as well as two bow anchors. At the stern of the ship the successive decks form a series of terraces from the upper deck to the stern, giving the tourist and third-class passengers both open and covered decks, with an excellent, unimpeded view of the ocean. In this connection it may be stated that all sports decks will be entirely free from cowls, ventilating machinery, winches, &c. The funnels will be of unequal descending height and of streamlined form, and will have smoke baffles fitted within them. Great care has been exercised in the subdivision of the ship and in the provision of safety devices, such as fire protective measures, improved navigation appliances, and modern life-saving equipment. There are eleven water-tight cross bulkheads in the length of the ship, with longitudinal bulkheads in the way of the engine and boiler-rooms, forming a double shell at the sides of the ship, which is further divided by cross bulkheads into fifty-four compartments, thirty of which are for fuel oil, and twenty-two for boiler water, with two permanently empty. The double bottom ballast tanks extend over the entire length of the ship, and are subdivided into forty-two compartments by water and oil-tight bulkheads. There are twenty of these tanks for boiler water, four for sea water, and eighteen for fuel oil. Aft there are four large tanks for drinking water.

At this stage of the ship's construction we need not refer in detail to her public rooms, except to say that the allocation and laying out of these saloons has been done with the collaboration of a committee of leading French architects. The flooring, decoration and lighting of all rooms and decks is to be carried out according to most recent standards, and with the assistance of French artists. Besides stairways, there are to be ten passenger lifts, and two for engineer officers from the machinery spaces to the sun deck where their quarters are provided. In the absence of more complete details, we can only refer briefly to the fifty-six pairs of lifeboats, including two motor boats with long-distance wireless equipment. These are carried on thirty pairs of Maclachlan davits. The navigating apparatus will include gyroscopic compass equipment, electric sounding mechanism and wireless directional finding gear, all of the most up-to-date type. The deck auxiliary machinery will include two electrically driven anchor capstans forward, and one aft, of 140 tons and 114 tons capacity respectively, working in conjunction with twelve 30-ton capstans for general manœuvring of ropes, &c. The electrical part of this apparatus will be worked on the Austin constant-current, variable-voltage principle, and has been designed by Gilbert Austin, Ltd., of Cathcart, Glasgow, the mechanical portion being made to the design of Napier Brothers, of Glasgow, the apparatus itself being largely made in France. A very extensive "Thermotank" ventilating apparatus forms part of the auxiliary equipment, and is being supplied to the design of Thermotank, Ltd., of Glasgow. As on the "Champlain," all fans and ventilator trunkings, cowls, &c., will be kept clear of the decks, which will be entirely unobstructed.

### Propelling Machinery.

The four engravings reproduced on the opposite page, show one of the turbo-alternator sets and one of the main double-armature propelling motors, which will drive three-bladed propellers mounted on short stub tail shafts, the motors themselves being arranged well aft in the ship. The whole of the quadruple-screw electrical equipment, including the six turbo-generator auxiliary sets, are being supplied by the

Société Générale de Constructions Electriques et Méchaniques (Alsthom), of Belfort. In the drawing below we reproduce a sectional drawing of one of the "Champlain's" boilers, which, we understand, is exactly the same as those to be used on the "Normandie." The general disposition of the generating and superheater tubes and the air heater may be clearly seen. These boilers have proved, we are told, very successful in actual operation. The turbines each have H.P. and L.P. wheels in separate casings and run at 2430 r.p.m. They are supplied with steam at about 400 lb. pressure, with a temperature of about 660 deg. Fah. The alternators are of three-phase enclosed marine pattern, and are fitted with air and oil coolers. The propelling motors have a speed range of 238 to 248 r.p.m., and are of the double-armature type, with the cooler arranged between the two stator casings, as indicated on page 462. They are directly coupled to the stub tail shafts, which carry the relatively high-speed propellers.




SECTIONS THROUGH 400 LB. PRESSURE BOILER

Further details of the machinery installation, other than those given in the accompanying table on page 463, include the twenty-three motor-driven forced draught fans supplied by James Howden and Co., Ltd., of Glasgow, the Cockburn-MacNicoll boiler and turbine valves, feed regulators, &c., by Cockburns, Ltd., of Cardonald, Glasgow, and the main and auxiliary feed pumps supplied by G. and J. Weir and Co., Ltd., Cathcart, and Drysdale and Co., Ltd., Yoker, Glasgow.

### The Launching Preparations.

A description of the Normandie, the largest ship in the world would not be complete without some reference to the actual launching operation. Saturday, October 29th, was chosen as one of only two days in the year at which the highest tide would take place. Even with this, calculations showed that when the ship had entered the water to almost her full depth there would be only 4ft. between the hull and the bed of the sea, a very small margin. The maximum weight of the hull in the launching state was about 30,500 tons, added to which the cradle and launching gear weighed another 1215 tons, bringing the moving mass up to practically 32,000 tons. Two concrete launching ways, each about 10ft. wide, and oak blocks of a total of 6354 cubic feet were employed. The greasing material included 43 tons of tallow, 2½ tons of lard, and 22 cwt. of soap, costing in all roughly £1600.

When we arrived at the yard the last side shores were being removed from the sides of the hull, and the keel blocks taken out, so that the weight was slowly transferred to the sliding ways. We noted five triggers on either way, and the starting effort was supplied by four hydraulic rams, two at the end of each way. The launching platform had been built high above the ship, and commanded a good view of the sides of the launching ways, where the last operations were being conducted by parties working to flag signals. There were, we were told, close upon 600 men employed on the launch. As the weight of the partly water-borne hull came on to the rear part of the cradle, a little heating took place, which was soon dispelled by the fire hoses in readiness. It is of interest perhaps to record that in the ceremony the blessing of the ship by clergy was not omitted, and that a "Jereboam" of champagne was shattered on her bows.

### The Luncheon.

The President of the Republic, accompanied by Madame Lebrun and the Presidential party, arrived at Saint Nazaire Station, where a civic reception was given. Shortly after 9.15 a.m. the party left the station and proceeded to inspect the shipyard and engineering workshops and the entrance lock. Luncheon was served in the Salle des Fêtes, and between four and five hundred guests were present.

The principal speakers were the President, Monsieur Lebrun; the Minister of Marine, Monsieur Leon Meyer; the chairman of the Penhoët Company, Monsieur René Fould; and the president of the Compagnie Générale Transatlantique, Monsieur Olivier. Monsieur René Fould's speech indicated the deep national feeling behind the new ship, and the pride felt in its successful construction.

After the launch the guests partook of a *vin d'honneur*, in one of the shipyard halls, when congratulatory speeches were made. In this connection, we would mention the names of Monsieur Coqueret, manager of the yard; Messieurs Conard and See, assistant managers, who had special charge of the launching arrangements; Monsieur Maroger, the chief naval architect; and Monsieur Pinczon, chief consulting engineer, who, with their many assistants and workmen, carried through without a hitch a launching operation of unparalleled magnitude. Finally, we would express our personal thanks to the genial hosts of the British party, Monsieur P. C. V. Le Brun and Mr. G. C. Rhodes, directors of the Compagnie Générale Transatlantique, Ltd., London, for the excellent travelling arrangements which made our journey a very pleasant one indeed.

## International Association for Testing Materials.

The eighth meeting of the Permanent Committee of the International Association for Testing Materials was held on October 3rd and 4th last at Florence, under the chairmanship of Dr. Walter Rosenhain, F.R.S., President of the Association. The Committee reviewed the financial position of the International Association and decided to issue a letter, through the President, calling the attention of certain countries to their moral obligations to the Association. Some countries, notably Switzerland, had already contributed more than their quota, but it is hoped that the remaining countries will also make an adequate response to the financial appeal which the Committee has been obliged to make.

The completion and issue of the Book of the Congress of Zurich in 1931 was reported, and the desirability of securing the further sale of this volume was emphasised. It is believed that the nature and value of this publication have not yet become fully known to many of those who might be interested in it so that a much larger sale should be attained; this is highly desirable if the future work of the International Association is to go forward vigorously.

The main question dealt with by the Permanent Committee at this meeting was the plan of work to be undertaken at and in preparation for the Congress which is to be held in London in 1935. It was decided in general terms that the work of the Congress should again be organised on lines similar to those which had proved particularly successful at Zurich. The work of the Congress will therefore be carried out in four sections or groups, namely:—A, Metals; B, Inorganic Materials, including stone, cement, concrete, &c.; C, Organic Materials; and D, Questions of General Importance. As Presidents of these groups the following gentlemen have now been appointed:—

*Group A.*—Professor C. Benedicks, of Sweden.
*Group B.*—Professor Suenson, of Copenhagen.
*Group C.*—Dr. F. Barta, of Prague.

For Group D—Questions of General Importance—the late Dr. Burgess, of Washington, U.S.A., had been appointed President. His untimely death unfortunately renders it necessary to appoint a new President for this group, but the appointment has not yet been made, as it was thought desirable to await suggestions from various countries. In each of these sections only a limited number of subjects will be discussed, the whole of one session being devoted, as was done at Zurich, to the discussion of a single question or group of questions. The selection of subjects with which it is proposed to deal has been provisionally made as follows:—

*Group A.*—(1) Corrosion.
(2) Light alloys.
(3) Welding.
(4) Progress of metallography.
(5) Behaviour under machining and abrasion.

*Group B.*—(1) Concrete and ferro-concrete.
(2) Testing methods for ceramic materials.
(3) Weathering of natural and artificial stone.

*Group C.*—(1) Textiles (artificial silks).
(2) Wood cellulose.
(3) India-rubber (caoutchouc).
(4) Preservation of timber.

*Group D.*—(1) Progress in testing machines and measuring appliances.
(2) Materials of construction in the laboratory and in service.
(3) Methods and concepts of physics and chemistry in their application to problems of testing materials.
(4) Sound and heat transmission of materials.

While it has been thought desirable to lay down in these general terms the subjects to be discussed at the Congress in London, it is realised that in the intervening period developments may occur which may make an alteration of this programme desirable.

In view of the financial stringency which the International Association feels, in common with the industrial and technical world upon which it depends for support, it may not be possible to issue any intermediate publications such as those issued some eighteen months before the Congress of Zurich. None the less, the work of the Association will be carried forward actively, mainly through the Presidents of the four groups and also by a number of international committees which have been appointed. The latter will carry on their work almost entirely by correspondence, but meetings in connection with them will take place at or immediately prior to the Congress in London in 1935.

In spite of exceedingly difficult circumstances it will be seen that the International Association is carrying on its work in an active and energetic manner, and an appeal is made for support in all countries, both from societies and institutions and industrial firms and also from all those individuals who are in one way or another concerned with the problems of testing.

The Secretariat of the International Association is at Zurich (Leonhardstrasse 27), and Professor M. Ros, head of the Swiss Federal Testing Laboratory, has consented to retain the onerous office of General Secretary until the Congress in London. The British headquarters of the Association are in the hands of Mr. G. C. Lloyd (Hon. Secretary and Treasurer) at the offices of the Iron and Steel Institute, 28, Victoria-street, London, S.W.1.

## A New Insulation Testing Set.

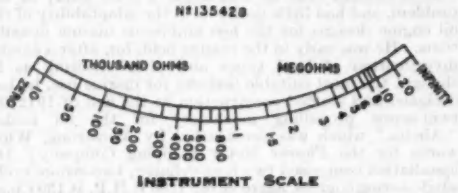
The work of Evershed and Vignoles in the direction of developing insulation testing sets is familiar to a large number of electrical men. As far back as 1889 Mr. Sydney Evershed introduced the first direct-reading insulation

SMALL "MEGGER" INSULATION TESTER

tester, which consisted of a portable ohmmeter and a hand-operated generator in separate cases. In due course, other sets designed to give better testing facilities and greater portability were produced, but the second principal step in the development of these instruments was made in 1903, when a testing set consisting of an ohmmeter and generator in a single case was put upon the market. Known as the Megger, and greatly improved since the time of its introduction, this instrument is still to be regarded as the standard insulation tester where very wide ranges of insulation resistance and high testing pressures are required, the highest range instrument reading up to 10,000 megohms, with a testing pressure of 2500 volts.

Ten years ago—see The Engineer, October 13th, 1922—another important step in the development of insulation testing sets was made. Realising that there was a demand for a smaller, lighter, and cheaper set, the

"Meg" tester was devised, with a weight of 6½ lb. While this set is not suitable for measuring the highest insulation resistance, it has proved invaluable to contractors and maintenance engineers in all parts of the world, and many thousands of "Meg" testers have been produced in Evershed and Vignoles' Chiswick works. But just as in 1922 the firm recognised the need for this cheaper and lighter set, so has it now deemed it desirable to market a cheaper and lighter set still, to keep pace with the development of the electrical industry. Electrical installations have become numerous, and the amount of apparatus that has to be maintained has vastly increased. A contractor or maintenance engineer may therefore require several insulation testers, and the "wee Megger" tester, shown in the accompanying illustration, should therefore meet with a good reception. With a weight of



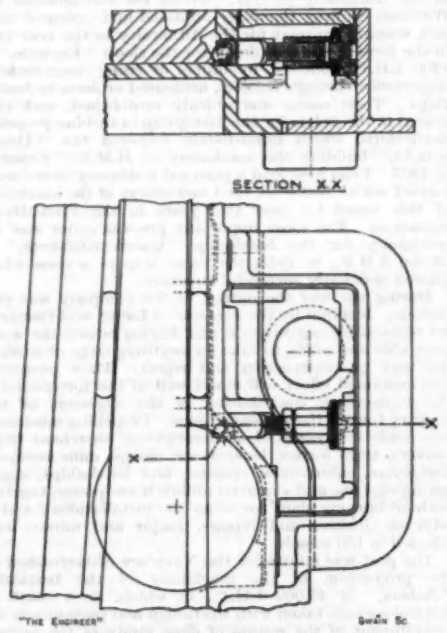

INSTRUMENT SCALE

only 3 lb., pocket dimensions, and an exceptionally low price, it should appeal to a great many people who have to make insulation tests. Designed and built for general use in the house, factory, workshop, power station, or out of doors, where the capacity of the circuit is not excessive, the set can scarcely fail to find a wide field of application.

The instrument is a true ohmmeter, working with a test pressure of 500 volts, and the design and workmanship conform with those of the more costly sets. The generator, ohmmeter, and all the other gear are enclosed in a neat bakelite case, and, as will be perceived from the illustration, the separate carrying case, supplied in metal or leather, may be used to support the instrument while the generator handle is turned. The arrangements that have been made at the Evershed and Vignoles' Chiswick works for the production of the new instrument are very perfect, and there is every reason to believe that the firm's business will greatly increase when the merits of the set become generally known.

## An Improved Railway Point.

THE accompanying line engraving shows the construction of a point recently brought out by Hadfields, Ltd., of Sheffield. A ball contained in a suitable holder, which

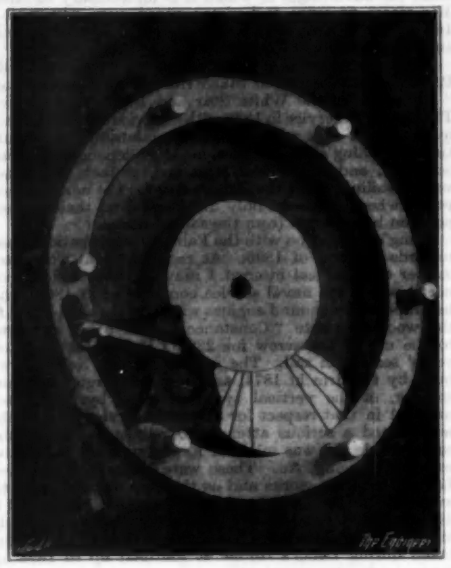



CONSTRUCTION OF RAILWAY POINT

is free to move in a lateral direction under the influence of two spring washers, is brought to bear on a bevelled recess in the heel end of the tongue of the rail in such a manner that pressure is exerted both downwards and substantially in a longitudinal direction towards the rear end of the tongue. It is claimed that by this means the tongue is held firmly down on the bed of the point and locked in position; that the tongue is maintained in alignment, and automatically adjusts itself at the heel end if wear takes place; and that the tongue moves more freely than is the case with the wedge and block system.

## The "Revolvo" Meter.

THE accompanying engraving illustrates a new meter for any fluid, invented by Captain E. O. Rippingille, Grosvenor House, Hagley-road, Birmingham. It consists, it will be seen, of a circular casing, with an annular passage around which a piston or rotor, as the inventor terms it, may pass. Supported on a square peg at one side of the casing there is a flap valve, which may lie close up against the outer side of the casing to allow the rotor to pass or alternatively can set itself radially across the annular passage. In action the liquid is admitted through the lower of the two ports to be seen in the engraving, and enters the space between the flap valve and the rotor. The valve closes, with the result that the rotor is forced round the passage until finally it pushes back the valve and falls into its original position. The liquid admitted and now occupying the upper part of the annular passage may be discharged out of the meter through the upper of the two ports. Thus for every revolution of the rotor a quantity of liquid is measured out, while counting may be performed by connecting the



THE "REVOLVO" METER

recording mechanism to the spindle of the flap valve. It is claimed that tests have shown this meter to be accurate under various pressures and vacua, and under gravity heads, and it is stated to be suitable for any liquid or gas that can be passed or forced through it.

## CANALS BECOME RAILWAYS.

IN two American cities—Newark and Cincinnati—old obsolete and abandoned boat canals that had become nuisances and obstructions to development have been converted into underground tramway lines to relieve the traffic congestion on the streets, while the roof serves also to form a new thoroughfare or boulevard. At Cincinnati, unfortunate financial conditions have prevented the use of the new rapid-transit line, and the tramway or street railway company and the city authorities have not been able to agree upon an operating contract. At Newark, the new line is about 6 miles long, partly in tunnel and partly in open cutting, with high retaining walls. The tunnel or cut-and-cover portion has a concrete floor supporting three lines of columns carrying transverse roof beams of rolled steel joists with a concrete slab roof. The boulevard above this is about 60ft. wide, without footwalks. In the outlying portion the shallow cutting has earth slopes, with fences along the top. Inclines connect the city end of the underground line with the surface tracks of the tramways. A number of bridges span the boulevard, and at one street an inverted syphon was built to carry a 90in. sewer under the subway line. This concrete structure includes also a pipe gallery for water and gas mains and electric conduits. The work is a municipal enterprise, but improvements in the railway stations and terminals have been built in relation to it. At two other cities—Dayton and Syracuse—stretches of similar obsolete and abandoned canals have been utilised in improving the railway lines passing through the business districts.

## BRITISH STANDARDS INSTITUTION.

*All British Standard Specifications can be obtained from the Publications Department of the Institution at 28, Victoria-street, London, S.W. 1. The price of each specification is 2s. 2d. post free, unless otherwise stated.*

### FOUNDRY PATTERNS.

No. 467—1932. There are at the present time a number of conventions in use in this country in regard to the marking and colouring of patterns, the object of the markings being to indicate whether the article to be cast is to be in iron or in non-ferrous metals, to indicate the position of cores, the seats of core prints, stop-offs, and whether machining is required.

It is clear that it will be a matter of great convenience to the industry to have a uniform convention adopted so that all patterns reaching a given foundry will be marked in the same kind of way.

The scheme adopted has been chosen so as to interfere to the smallest extent possible with current practice in the country, but as the practice varies it obviously is necessary for some people to make changes in order to line themselves up with the specification. It is felt, however, that the gain which will result from the adoption of a uniform convention is so great as to justify the small amount of trouble which will be involved in certain cases in putting it into operation.

## The Work of Andrew Laing.*

By Engineer Vice-Admiral Sir REGINALD W. SKELTON, K.C.B.

IT was with a full recognition of the responsibilities to be incurred that I acceded to the invitation with which your Council honoured me to give this inaugural lecture. While I feel that your choice rested upon considerations of my office rather than individual qualifications, I can say that my personal inclinations to be party to a public appreciation of the work of such a great leader in our profession were quite in line with what I conceive to be the duties of my office, and I found no difficulty therefore in reaching a decision.

The Council suggested that this lecture should cover particularly Andrew Laing's work and influence, and, fully agreeing with their views, I have followed this course.

In the year 1877, when Andrew Laing joined the design staff at the Fairfield works of John Elder and Co. at Govan, Alfred Holt, the founder of the Ocean Steamship Company, commonly called the Blue Funnel Line, read before the Institution of Civil Engineers a paper which marked the progress attained in the previous twenty-five years in steam shipping.

In this paper the writer recorded a considerable transition of British carriage by sea from sail to steam.

At this time, 1877, the three design features which had contributed principally to the transition from sail to steam had found for all practical purposes general acceptance in ocean-going ships. These features were:—

1. The use of iron for shipbuilding.
2. The use of the screw in place of the paddle wheel.
3. The adoption by first design or, by modifying the initial design, of the compound principle.

Of the three features mentioned, the adoption of compound working was the predominant influence in the revolution which changed the situation. By such means John Elder had as early as 1856 reduced the fuel consumption from 4 lb. to 2½ lb. per S.H.P. hour. His place in engineering history is secure, and although he had passed on some eight years before Laing entered the works, the traditions he developed had continued through Jamieson, Kirk, and Bryce Douglas. Kirk designed in 1874 the triple-expansion engines of the "Propontis," when he had to consider the best engine to use advantageously the high-pressure steam which W. H. Dixon, the Liverpool shipowner, had decided to employ to obtain further economy for his ships. As is well known, the engines were quite successful in themselves, but the experiment failed by reason of difficulties with the water-tube boilers, a type which was alone then suited to handle the relatively high pressures whose use was being sought. In mentioning the "Propontis" it is only proper to mention here a smaller marine design which somewhat anticipated her. I refer to the "Sexta," which was fittted with triple-expanson engines for 120 lb. pressure, built by the Ouseburn Works in this city, and tried in 1874. The pressures in these triple-expansion designs, although much in advance of the average, were themselves greatly surpassed by the designs of Loftus Perkins, whose engines, in association with his water-tube boiler for 600 lb. pressure, were in successful use to a limited extent on shore and also in 1877 on a small scale afloat. A year or two later the ferry steamer "Loftus Perkins" ran on your river successfully for some years. In general, however, in marine practice the steam pressures were round about 60 lb. per square inch, and the boilers generally of the return-tube cylindrical type, and most of the engine and ship forgings, were of iron. The time was over ripe for a change in respect to engine forgings, for under the advancing design demands the mortality of wrought iron engine shafts was high. It had been recorded that in some lines the life of a crank shaft averaged from three to three and a-half years, but a proper standard of reliability was gradually obtained by the use of built-up steel shafts and the more even turning moment which attended the use of the improving engine types. The boilers were invariably coal fired in ocean-going ships, but experiments had been carried out here and there with oil fuel, and, favoured by the facility of supply, this fuel was in marine use on the Caspian and on the Volga and Neva. The auxiliary engines were of the simplest form and most were main engine driven. The amenities and augmented food supplies attending the use of refrigerating machinery were not then available, but the spade work was being done by Coleman and Kirk, curiously enough both in connection with the home production of liquid fuels and by-products from shale in Scotland.

Ocean-going ships were single screw and they were all equipped with sails to a moderate extent to serve as auxiliary when circumstances favoured their use or as the means of advance in the event of machinery breakdown. On the Western Ocean the passage from Queenstown to New York took between eight and eight and a-half days.

In respect to research work, William Froude had laid solid foundations for later advances in ship propulsion and comfort of transport and had confirmed by the famous full-scale towing experiments with the "Greyhound" his law of comparison.

Thus the stage was set for great advances in speed, reliability, comfort, and convenience, and the hour was to find the men ready and able to take advantage of the access of knowledge and to carry forward the work of such leaders as the Maudslays, Napier, Penn, and Elder, and to further the cause of civilisation by improving the facilities for free intercourse between the peoples of the world.

Whereas the initial battle for marine fuel economy which contributed so largely to the displacement of sail was fought out on the Pacific, the developments which led to the large advances in speed and size of ocean-going vessels were applied in the Atlantic service. A gradual improvement in speed was noticeable from 1856 onward, but the length of passage time was not seriously reduced until the "City of Berlin" (Inman) and the "Britannic" (White Star) came on service in 1874 and 1876 respectively. These vessels averaged consistently between 14 and 15 knots on passage and were indeed capable of making good 400 nautical miles daily. Their performance was surpassed by that of the "Arizona," laid down by John Elder and

* From the first Andrew Laing Lecture. North-East Coast Institution of Engineers and Shipbuilders, Bolbec Hall, Newcastle-on-Tyne, October 28th.

Co. for the Guion Line about the time Laing joined the organisation. It was with the propelling machinery of this vessel that he began under William Pearce and Bryce Douglas his association with fast ocean-going liners whose development he was destined so greatly to influence. The "Arizona" came on service in 1879 and proved superior to the existing Atlantic liners in speed on service. Like all the big ships of the day, she was a single-screw iron ship, and the staunchness of her construction was proved by her survival of an encounter, in her early days, with an iceberg, when running at 14 knots. With a steam pressure of 90 lb., her three-crank compound engine developed 6000 S.H.P. at 90 revolutions per minute, giving her a service full speed of about 16½ knots. She averaged about 15½ knots on her first double passage, and was indeed capable of maintaining 16 knots on passage, but the coal consumption, 125 tons per day at those higher speeds, was regarded as ruinous in the commercial sense. In some respect the "Arizona," with an appreciation for the need for machinery durability and the reputation which the observance of a regular sailing schedule brings, anticipated some features which were to find rapidly increasing use afloat, including built-up steel crank shafts (a system first made on a large scale by Vickers for the "Britannic"), steel propeller shafts and boilers, and bronze propeller blades.

There followed, between 1880 and 1885, a period of competition between the Guion, Cunard, and Inman lines, and the single-screw iron vessels "Alaska," "Servia," "City of Rome," "Aurania," "Oregon," "Umbria," and "Etruria," together with the "America" for the U.S. National Line, were successively produced. The "Alaska" was the first vessel to be styled the "Greyhound of the Atlantic," the expression having originated in the days of her early service when she continued voyage by voyage to beat her own record. The machinery design of all these ships continued the three-crank compound design, but on an increasing scale of power all the time, culminating in 1884 in the "Umbria" and "Etruria," designed for 14,000 S.H.P., which, together with the "Oregon" (turned over from the Guion Line to the Cunard Line), were all by John Elder and Co. In this group of vessels is to be noted the beginning of the general application of electric generating machinery for lighting, which was to add so greatly to the amenities of ocean travel besides decreasing the risk of fire.

The "Umbria" and "Etruria" represented, not only the last word in the compound engine, but also by far the highest-powered units on a single shaft then built, being capable of developing 14,500 I.H.P., and this power on a single line was never very much exceeded by any subsequent reciprocating engined design until the "Deutschland," of 16,650 I.H.P., was built in 1900. The length of the ship was limited to that of the predecessors by reason of the docking facilities then available, and in consequence the burden of getting the desired advance in speed had to be assumed mainly by the engine design. It was, we can readily suppose, a job after the heart of Laing, then chief draughtsman, a post which he won after four years' service through sheer unaided ability and force and determination of character, coupled with close application to his work and professional study.

The one exception to the regularity of their service, I refer to, the classic case of the fractured thrust shaft of the "Umbria" in December, 1892, recalls the situation in the early 'eighties, when the dependence of large ships on a single engine was brought into great prominence by the serious number of shaft failures leading to great losses to owners and underwriters. Between the years 1881 and 1884 no less than 224 steamers had been reported disabled by broken crank or driving shafts. Those shaft failures were mainly those of the solid forged iron shafts then used for crank shafts in which the method of manufacture, involving the welding up of a number of component pieces, left a great deal to be desired in point of homogeneity and soundness. The more advanced makers had meantime corrected this weakness to a large extent by the use of steel coupled with the built-up method which allowed of easier and better-worked materials, but the steel forging in the highly dependable form now universally available was yet to come, and various weaknesses remained.

The use of increasing boiler pressures, made possible by the availability of steel and the improving workshop methods, had meantime brought the compound engine to much the same position as when it replaced the simple engine in so far as advances of steam pressure were not attended by a proper gain of economy, due to the effects of condensation. As a result of experience on service and the availability of high steam pressures, made possible by the use of steel boilers and improved manufacturing methods, the triple-expansion engine by the year 1886 was recognised as the correct and convenient type for general use in the mercantile marine if proper advantage of the fuel economy which should attend the use of the higher steam pressures was to be realised. Actually the first Atlantic liners to be fitted with triple-expansion engines were the "Aller," "Trave," and "Saale" of 7000 I.H.P., built by John Elder and Co. for the Nord Deutscher Lloyd in 1885 and 1886 during Laing's tenure as chief draughtsman. It should be mentioned here that John Elder and Co. had removed their engine works from Centre-street, Glasgow, to the present Fairfield Works at Govan in 1874 and that the name of the firm was changed to the Fairfield Shipbuilding and Engineering Company in 1886. A more striking design followed in 1887 for the "Lahn," of 9000 H.P., also for the Nord Deutscher Lloyd; in this design the demand for high engine power was met without increasing sensibly the length of the engine, by a five-cylinder design in which a high-pressure cylinder was disposed over each low-pressure cylinder with a single intermediate-pressure cylinder in between on the third crank.

The combination of twin screws and triple-expansion engines was applied in the "City of New York" and "City of Paris" of 18,500 I.H.P. for the Inman Line in 1888 by J. and G. Thomson. Not unnaturally a special point was made by the owners of the freedom from risk of complete breakdown or even delay in passage which might be expected to attend the use of twin screws, and it is singular therefore that on the first voyage of the "City of Paris" in April, 1890, the failure of the tail shaft of one engine entailed, not only the wreckage of that engine, but the flooding of the other engine-room and the entire loss of power.

Under Laing, who became manager of the engineer department on the vacation of this office by Bryce Douglas, in 1887, the Fairfield Engine Works had been modified and reorganised at considerable expense and were well capable of handling such large machinery and boilers as that of the "Campania" and "Lucania," 30,000 I.H.P., so that her engines were practically completed within twelve months of the placing of the order, notwithstanding that other important work was also passing through the shops at the time. The installation was, of course, twin screw with triple-expansion engines, embodying a five-cylinder design similar to that developed for the "Lahn," this permitting relatively small cylinders and a short engine base, the advantages of which it is unnecessary to stress. The steam pressure and piston speed were advanced to 165 lb. per square inch and 1000 f.m. respectively with engine revolutions 84 per minute.

With these vessels the Cunard recovered the Blue Riband which had been taken from the "Umbria" and "Etruria" by the White Star and Inman Line vessels. They came on service in 1893 with a service speed approaching 22 knots. The machinery fully maintained the reputation of Laing's earlier designs for dependability and economy, and the vessels remained, in fact, the fastest vessels sailing under the British flag for the next fourteen years, when they were only displaced from their eminent position by a design from the same hands.

Laing's connection with the Fairfield organisation ceased towards the end of 1895. As regards naval work, as a matter of historical interest I may say that Elder's connection with the naval service commenced in 1860, when he proposed compound engines with surface condensers for the wooden frigate "Constance," then being converted to the use of the screw for 2300 I.H.P. after seventeen years' service in sail. The ironclad ship "Nelson" was built by the firm in 1874, and her twin-screw compound engines, of the vertical type, designed by Kirk, were unusual in that respect for the naval service and further represented a serious attempt to reduce weight so that considerable use was made of forged steel for bed-plates, columns, bracing, &c. These were being installed when Laing joined the works and as the ship did not leave the works to run the trials until 1878 it is quite likely that he did not miss the opportunity of attending them and studying the design at work. The other naval designs undertaken during Laing's *régime* at Fairfield up to 1894 call for no particular comment.

Laing joined the Wallsend Slipway and Engineering Company late in 1896 as general manager. Until then the machinery produced had been mainly for cargo steamers of moderate power, but he was not content with such a narrow application for his talents and exclusive experience in producing world famous designs. Accordingly he at once reorganised the works and enlarged their capacity and equipment to a scale consistent with handling and repairing the largest types of machinery for ocean liners and warships then made with very wide margins over and beyond the evident requirements to meet the probabilities which he knew would surely eventuate. Truly he builded big and his perspicacity was justified in full measure by later events. Nevertheless, if at that time the probability or even possibility of a six-figure horse-power in a single ship had been raised specifically, it would have been scouted as an extravagant suggestion, not only by reason of the technical difficulty of execution, but in the light of the colossal cost in respect of docks and wharf extensions that would be entailed as a preliminary to the advances in ship designs which would have to attend such a great engine power. So is our vision dimmed by the surrounding difficulties, but Laing knew that the need for advance would persist and lead to the breakdown of the strongest barriers.

### Oil Fuel.

Experiments burning oil fuel under boilers had been made by the Admiralty at Woolwich Dockyard as early as 1841 and oil fuel burning steamers were running regularly on the Caspian and on the Volga and Neva in the 'sixties. The Wallsend Slipway Company were early in the field, and they fitted out the s.s. "Gretzia," in 1881, for oil burning, usirg, I understand, a steam atomiser system. Several other experimental marine installations are on record from 1885 onward, but the first oil-burning steamer engaged in continuous sea service appears to have been the s.s. "Bakuin," in 1892.

Laing took the closest interest in the application to sea-going vessels and, having reached the opinion early in the 'nineties that the use of liquid fuel was bound to extend rapidly when the necessary supplies came in sight, he spared no cost or effort to develop commercial appliances. His work here exemplifies one of his frequently expressed principles, that where there is a measure of certainty of commercial success and material reward, the necessary ingenuity and effort to overcome the greatest mechanical difficulties will be forthcoming. So by the time the supplies, distribution, and price of liquid fuel had become sufficiently stable to warrant the general commercial application where advantages offered, the Wallsend Company was ready with suitable designs to supply the need. That such designs were applied with no serious setbacks is a tribute to the solidity and suitability of the details of the design and accessories, coupled with the wide experience of conditions afloat available at the Wallsend Works. The earlier designs were steam pulverising types, on the Rusden and Eeles system, but it was appreciated from the beginning that the fresh-water consumption attending their use would be unacceptable as a permanent measure, and efforts were continually directed to develop a pressure system of pulverising. A pressure system had, in fact, been used by the Wallsend Company in 1884, in the tank steamer "James Brand," and the Korting burner was considered in 1900, and taken up to be developed for marine use in 1902. In 1909 the manufacture of the Wallsend-Howden pressure system was commenced, and this system has since been almost exclusively used. The position of the Wallsend Company as pioneers in this far-reaching commercial application is attested by the fact that by the year 1908 nearly 100 sea-going vessels had been equipped with their oil-burning plant.

Laing's judgment as to the commercial return was adequately fulfilled, for, considered on a gross tonnage basis, the growth of installations burning oil fuel under boilers has been twenty-fold since 1914. Lloyd's Register records the turning point in 1920–21, and their report for that year reads: "a position has been reached when it is to be recorded that of the steamers built to class during the year, those propelled by the use of oil exceeded in total tonnage those fitted with boilers for the use of coal only." As Laing himself said, the question of the use of oil for boilers of merchant ships is largely one of pounds, shillings, and pence.

He was not so clear as to the outcome in the case of the heavy-oil engine for marine use, and here it is evident, as may be expected, that he had prominently in his mind the fast Atlantic liner. His evidence, given before the Royal Commission on Oil Fuel in December, 1912, gives in essentials the principal difficulties in the application that have endured, bearing in mind that the fast-running geared oil engine had hardly then been visualised. His final dictum that we have a lot to learn, and it will take time, is characteristic of his outlook.

It is evident that he had made a close study of the problem, and had little doubt as to the adaptability of the oil engine designs for the less ambitious marine installations. He was early in the marine field, for, after a careful investigation of land types and after choosing as he thought the most suitable features for marine use, he had designed and started construction at the end of 1912 the twin-screw propelling machinery for the oil tanker "Abelia," which was constructed by Armstrong, Whitworth for the Flower Motor Shipping Company; the installation comprised two four-cylinder, two-stroke cycle, single-acting engines, aggregating 1200 B.H.P. at 130 r.p.m. At this time the "Selandia" had completed her second voyage, and the "Vulcanus" and "Jutlandia" were just on service, these three vessels being the only representatives of the heavy oil-engined type among ocean-going ships.

### Naval Work.

My predecessors and I have frequently and gladly testified to the great value the Admiralty design staff attach to the contact with mercantile marine engineering practice which is afforded by those engineering concerns specialising in both mercantile and naval work, and to the benefit which accrues to naval designs from that association. It will be evident that the experience which is yielded by the successful day-in-day-out performance of the advanced mercantile designs affords a most comforting background for those still further advances in design which the needs of the naval service so frequently evoke. Then, too, the keen competition which is an essential feature of commercial work, entails the closest scrutiny of material characteristics and manufacturing methods to ensure the minimum expenditure of material and labour in production; this leads invariably to a simplification from which naval designs derive benefit, notwithstanding that the underlying motives do not there operate to the same extent. Above all, the confidence which success in commercial work inspires lends a sincere and robust character to the criticisms which naval designs are bound to provoke when viewed in the light of commercial designs, and in many cases to their benefit. In no cases were such contributions more valued or respected than from Andrew Laing, whose name will ever retain an honoured position in the Admiralty records. Under his management the Wallsend Slipway Company obtained and executed their first warship contract for the Admiralty in the year 1900 in the form of the machinery for the sloop "Espiegle," of 1400 I.H.P., followed by orders of rising magnitude of importance through cruisers, armoured cruisers to battleships. Their name was quickly established, and they shared in the orders for the first group of turbine-propelled battleships, which immediately followed the "Dreadnought," building the machinery of H.M.S. "Superb" in 1907. I can here lend a personal testimony to the work carried out at Wallsend, for I had charge of the machinery of this vessel for over two years in the First Battle Squadron. The most important pre-war order was the machinery for the battleship "Queen Elizabeth," of 75,000 S.H.P., in 1913, the name ship of a class which proved eminently successful steamers.

During the war the output of the company was prodigious. Inspired by the example of Laing, and thanks to his remarkable organisation and driving power, the works were able and ready to take on anything large or small in the way of construction and repair. Their wonderful and sustained effort will stand well in the foreground of the tremendous contribution of the engineers of this country toward the successful issue. Propelling machinery was made for vessels of all descriptions, merchant ships, tankers, train ferries, icebreakers, sloops, mine-sweepers, destroyers, submarines, cruisers, and battleships, aggregating over one and a-quarter million horse-power, together with oil-burning plant for some 200 installations; and in addition docking and repairs, major and minor, were effected in 150 vessels.

The post-war efforts for the Navy are distinguished by the production of the machinery of the battleship "Nelson," of 45,000 I.H.P., in which, as a result of meticulous care taken with the design and particularly the embodiment of the results of close study of the turbine blading and nozzle details, the results as regards fuel consumption were in advance of that expected, although the standard laid down in the Admiralty design was itself much ahead of past practice; this exemplifies the point I made earlier and the argument adduced by Laing in the 1902 letter from which I have quoted, that engine builders should themselves be in a position to contribute something to a design, however advanced it may appear. The post-war T.B.D.'s were similarly outstanding in fuel consumption, reaching down to standards which would have been regarded as unattainable but a few years back, while making ever advancing cuts in the requirements for machinery weight and space without abandoning anything in the way of reliability.

The post-war mercantile work is noticeable in its later phases at least by the predominance of heavy oil-engined installations for which Laing had developed the Wallsend-Sulzer two-stroke type; but this is, I imagine, attributable to the demand of shipowners following a fashion rather than to any predilection by him for the type over steam plants; indeed, in common with most of the leaders who were associated with the design and production of the high-powered marine steam engines of the 'nineties, he was well aware of the inherent disabilities of the large-scale reciprocating engine and, I believe, confident that it would not in the long run endure.

I have spoken so far of the work rather than the man and then inevitably in a discursive way, indicating but

the more prominent landmarks in his long career—for it is given to few to work continuously for over fifty years almost entirely in a directing capacity in one branch of the engineering industry and to be associated there with such far-reaching changes and advances.

Those of us who knew him and worked with him in business or on some of the numerous conferences and committees dealing with maritime and national issues which benefited from his long and mature experience, can hardly fail to recall his vigour and independence of thought and his accurate judgment ever inclining toward prudence and caution, but well tempered by an appreciation of the necessity for continuous progress.

Those who worked with him and for him from day to day do not need me to say that he, "pulling and hauling with the Mariners," had a full and sympathetic understanding of their hopes and aspirations and that they were better engineers, and, above all, better men for their contact with his keen, eager, and virile personality. Many could tell of his loyalty to those who served him well.

In the purely material sense it will, I think, be agreed that he had but little use for personal success, and although it attended his work in full measure, his joy lay in doing well the work that lay at his hand or was conceived in his fertile mind. Andrew Laing will not be remembered for any epoch-making invention, but for those of the generations which knew him he will remain a shining example for his single-minded devotion to his life's work, the advancement of marine propulsion.

## Provincial Letters.

### THE MIDLANDS AND STAFFORDSHIRE.

*(From our own Correspondent.)*

**Progressive Expectations.**

TRADE prospects for iron and steelmasters, engineers, and manufacturers throughout the Midlands and Staffordshire continue to improve, and confidence increases. The tariffs decision has settled the minds of iron and steelmasters, and they feel that they can now plan ahead for, with two years' protection practically assured, they are likely to be relieved to some extent of the severity of undercut prices by foreign rivals. They would much like to know whether the present attitude of the foreigner towards business here can be interpreted as meaning that he has decided to give up selling iron and steel at below production costs. At the moment the decline in values of sterling has practically cut the foreigner out. Gradually the relative position of British and foreign materials has altered, until at date a good many native steel products are at least on a competitive footing, in spite of the fact that the foreigners' prices do not permit of any profit. The chances are that the finishing trades will in future make greater use of home resources for their raw material, and consequently producers of iron and steel are more cheerfully disposed towards the future. There was very little business being done this week with overseas suppliers, and it is reported that stocks of foreign material at the works in the Black Country are gradually being eaten up. When they need renewing, as they soon must, there are sure to be some acceptable orders available for native iron and steelmasters. District manufacturing works are engaged below capacity, but there are promises of expansion of trade alike in this country and with the Dominions.

**Iron Prices.**

As anticipated, the Central Pig Iron Producers Association at its monthly meeting decided to make no change in the selling rates ruling during October. Business is much the same as recorded in this letter last week, but it is now evident that while some blast-furnacemen are receiving orders for larger tonnages, the general experience of Derbyshire and Northamptonshire furnaces is that consumption of foundry and forge grades of iron is no more than maintained. Basic pig is, however, in better request, smelters having recently obtained some very useful orders. Output of iron from Midland furnaces is slightly in excess of consumptive requirements, and specifications are needed by all furnacemen. In a number of cases stocks are still increasing, despite the efforts being made to dispose of them in Northern markets at prices lower than those ruling in this district. The heavy engineering foundries in this area are still very short of work, and most of the iron called for is needed for the production of light castings. Furnacemen are hopeful of a turn in the tide, and many believe that the consuming industries are now beginning to discuss brighter prospects. It is stated that some users at the recent quarterly meeting in Birmingham intimated the possibility of their requiring larger tonnages of iron towards the end of the quarter. Practically no foreign pig iron comes into this district, and, if, as is expected, local works improve their position as a result of the protection now afforded them and of the depreciation of sterling, the betterment will be passed on to Midland smelters. These latter are certainly hoping for, at the very least, a great reduction of their stocks before the close of the year. Business in hematite in this district is spasmodic. Mixed numbers of East Coast hematite are quoted here round about £3 17s. per ton. The minimum selling prices of Midland brands of forge and foundry iron, as reaffirmed, are as follows:—Northamptonshire: Forge, £2 17s. 6d.; No. 1, foundry, £3 5s. 6d.; No. 2, £3 4s. 6d.; No. 3, £3 2s. 6d.; No. 4, £3 1s. 6d. Derbyshire: Forge, £3 1s.; No. 1 foundry, £3 9s.; No. 2, £3 8s.; No. 3, £3 6s.; No. 4, £3 5s.—delivered at stations in the Black Country and subject to rebate.

**Steel.**

The tone prevailing in the steel trade slowly improves, despite the fact that the heavy engineering industries are not taking any larger tonnages of material than has been the custom of late. The demand for constructional steel is poor in all departments. Steel makers have received more inquiries and orders for good quality strip, a material used for a variety of purposes, including tubes and certain components in the cycle and motor trades. The sustained activity in these industries has been helpful in finding work for the steel rolling mills, where there is such a lack of contracts from the heavy industries. Prices of finished steel show no change. Angles are quoted £8 7s. 6d., less 15s. rebate; tees, £9 7s. 6d., less 15s.; joists, £8 15s., less 22s. 6d.; ship, bridge, and tank plates, £8 17s. 6d., less 15s.; boiler plates vary in price from £8 7s. 6d. to £8 10s. In the semis department the main feature is the rise in prices of foreign steel. Quotations have advanced considerably, and there is little new business being given out. Birmingham merchants regard the present price movement as a passing phase, but many consumers are not in agreement with them. For the present business in Continental material is at a standstill, consumers not being in urgent need of supplies. Staffordshire re-rollers on account of the advance in raw material prices have further advanced their quotations. They now ask £6 15s. upwards per ton for small steel bars re-rolled from Continental billets. All-British bars are unchanged at £7. Demand has improved somewhat. This is also the case with billets. There have been some inquiries for forward supplies, and it is reported that some misgiving has been caused, now that Continental material is being held for higher prices, by the attitude of some home makers who are stated to be rejecting business offered at the scale of graduated prices fixed some time ago. The minimum of £4 17s. 6d. for lots of 500 tons or over does not now seem acceptable to some steelmasters. The matter is obviously one of importance, and if reports are correct the development of the situation will be awaited with interest. Prices of sheet bars stand at £4 15s. upwards, and of Staffordshire hoops at £9 10s.

**Manufactured Iron.**

There is no development of note in the finished iron trade in Staffordshire. The bulk of the orders coming to hand is for small tonnages and relates chiefly to supplies of best grade material. Wrought iron strip mills are doing a little better, the volume of demand gradually increasing week by week. Finished iron prices are unchanged. Marked bars make £12 per ton at makers' works. Crown bars are quoted £9 upwards, nut and bolt bars £8, fencing bars, £7 15s., and tube strip £10 7s. 6d. to £10 10s. per ton delivered.

**Galvanised Sheets.**

Demand from overseas for galvanised corrugated sheets has gained ground, while there are additional inquiries in circulation. Moreover, under the agreement which has been fixed between British and Indian manufacturers of galvanised sheets, preferential treatment is afforded for the entry of British sheets into India, and it is hoped that this trade, which was a flourishing one in the past, will be stimulated. Values remain unaltered at £10 per ton f.o.b. for 24 gauge sheets. In the home market business has fallen away since prices were advanced. The market seems undetermined as to how to act. Consumers resent the action of sheet makers, and they are holding off the market. The quotations agreed upon by manufacturers are being adhered to alike for galvanised and black sheets; they range from £11 5s. to £12 15s. and from £9 5s. to £10 15s. respectively.

**Signs of Progress.**

Proposing the toast of the evening, "The Co-ordinated Societies," at the annual dinner of the Staffordshire Iron and Steel Institute, the Birmingham Metallurgical Society, and the Birmingham Section of the Institute of Metals on Saturday last, the Lord Mayor of Birmingham, Alderman J. B. Burman, mentioned that since the formation of the Co-ordinating Committee the membership of the societies had increased, and now stood at 850. Referring to the present condition of industry, he said that he was very hopeful of a return to prosperity. He considered that the right turning in that direction had been taken, and that trade was improving. As evidence of this fact, he stated that he had been informed that within the last month unemployment had decreased in the Midlands to the extent of 45,000; of that number, between 4000 and 5000 related to Birmingham. That was a good sign. He pointed out that whereas six years ago there were only six canning firms in this country, to-day there were more than sixty. That was a sign of increasing enterprise. Mr. W. F. Brazener, the chairman, in responding, said that the Co-ordinated Societes existed for the purpose of developing a knowledge and a technique of metals. By doing that they were performing something which was not only necessary, but which was beneficial to industry and the country as a whole.

**Work for the Midlands.**

Orders for machinery for Russia recently placed with Midland firms, as given in the current issue of the *Bulletin* of the Russo-British Chamber of Commerce, include the following:—Electric generators and motors, switchgear and winding equipment (£150,000), Metropolitan-Vickers Electrical Company, Ltd.; tube rolling mill (£90,000), the Wellman Seaver Rolling Mill Company, Ltd., Darlaston; electric resistance furnace (£60,000), the Birmingham Electric Furnace, Ltd., and the Electric Resistance Company, Ltd., Birmingham; machine tools (£20,000), B.S.A. Tools, Ltd., Birmingham; compressors (£5000), Bellis and Morcom, Ltd., Birmingham; petrol pumps, A. C. Sphinx Sparking Plug Company, Ltd., Birmingham.

### LANCASHIRE.

*(From our own Correspondents.)*

MANCHESTER.

**Work for Locomotive Engineers.**

THE reports current nearly three weeks ago of the projected placing of a Russian order for twenty-six locomotives of various types, valued at more than £100,000, with Beyer, Peacock and Co., Ltd., of Gorton, Manchester, have been confirmed. The business will be more than welcome for a branch of engineering which, in Lancashire as in other parts of the country, has been badly hit during the past few years by the world depression. So far as Lancashire is concerned, the order is probably the biggest individually since that placed by the London, Midland and Scottish Railway Company with the same firm several years ago for thirty Garratt engines. Incidentally, it will provide a useful addition to steel works order-books, for the demand for acid boiler plates and other locomotive-building material has been on a very disappointing scale for some considerable time. This will readily be appreciated when it is recalled that in the recently issued annual report of the directors of the Vulcan Foundry, Ltd., of Newton-le-Willows, it was stated that in the experience of the British locomotive industry the market had decreased by about 90 per cent. compared with recent years, and that during the past twelve months the Vulcan works had been employed only to about 10 per cent. of capacity. Mr. L. Mather, of Mather and Platt, Ltd., Newton Heath, Manchester, and chairman of the Russian Section of the Manchester Chamber of Commerce, regards the locomotive order referred to as evidence that there is business to be done with Russia, and, he adds, amply demonstrates the need for a new Anglo-Russian trade agreement as soon as the present one is ended.

**An Offer Rejected.**

An offer was recently made by Textile Machinery Makers, Ltd., Manchester, for the purchase of the business of Tweedales and Smalley, Ltd., textile machinery manufacturers, of Castleton, near Rochdale. This offer was considered at a meeting of shareholders of the latter company last Friday, and was rejected, the voting being 259,636 for acceptance and 413,477 against. Mr. W. Davidson, the chairman of the company, said that the position of Tweedales and Smalley was much stronger to-day than it was twelve months ago, the production during the past year being double that of the previous twelve months, and the order books were sufficient to keep the plant operating on a full-time basis for about fifteen months. Textile Machinery Makers, Ltd., thus remains constituted as it was at the time of its formal registration a little over a year ago. The six well-known Lancashire textile machinery concerns that were involved in the merger had a combined capital of more than £8,500,000, and included Asa Lees and Co., Ltd., Oldham; Brooks and Doxey (1920), Ltd., Manchester; Dobson and Barlow, Ltd., Bolton; Howard and Bullough, Ltd., Accrington; John Hetherington and Sons, Ltd., Manchester; and Platt Brothers and Co., Ltd., Oldham.

**Bridge Widening Scheme for Stockport.**

A scheme for widening and reconstructing Mersey Bridge has been approved by Stockport Town Council. The cost is estimated at about £17,000.

**University Appointments.**

Professor John Hollingworth has been appointed to the Chair of Electrical Engineering in the University of Manchester and the Manchester College of Technology, in succession to Professor Miles Walker, who has retired. Professor Hollingworth is to take up his appointment in the New Year. Mr. E. A. Fowler has been appointed Assistant Lecturer in Metallurgy and Assaying, and Mr. Joseph Bor Demonstrator in Physics.

**Non-ferrous Metals.**

Following upon last week's advance in all sections of the non-ferrous metals market, with the exception of copper, weakness has since been general, and whilst the decline in the case of both lead and spelter has not meant the loss of all the ground gained, the fall in tin, although not particularly heavy so far as this metal is concerned, has been sufficient to wipe out the rise of last week. Copper, however, has furnished real indications of weakness, and there has been a loss on balance for the week of between £1 5s. to £1 10s. per ton in standard brands. The statistical position of the metal grows worse rather than better, and there is no evidence of the trade demand improving. Business in the tin section has been on moderate lines. In this case prices are being maintained at about the £150 per ton mark, but there appears to be considerable difficulty in getting them to move much beyond it. Compared with a week ago, tin values are about £1 5s. per ton lower. Both lead and spelter are relatively steady in tone and are perhaps the most active sections of the non-ferrous metals market. Lead is cheaper by between 2s. 6d. and 5s. per ton, whilst spelter, which has declined to the extent of about 2s. 6d., has not lost much of the previous week's substantial rise.

**Iron and Steel.**

Except for the steady advance in values of Continental iron and steel products on the Lancashire market, trading conditions are rather humdrum in character, with the unfavourable labour development in the cotton industry a retarding influence on business expansion in iron and steel. There are odd instances of foundry iron users placing fair forward contracts, but these are in the case of the few better situated firms. The majority of Lancashire foundries are content to cover supplies from month to month. On the whole, deliveries into consumption keep up at about their recent level and prices are steady, with Staffordshire and Derbyshire No. 3 quoted for delivery equal to Manchester at 67s. per ton, Northamptonshire at 65s. 6d., Derbyshire forge iron at 62s., Scottish foundry at about 83s. 6d., and West Coast hematite at 81s. The bar iron trade continues quiet, but quotations are maintained at £9 15s. per ton for Lancashire Crown quality material and £10 5s. for best bars. The Russian order for locomotives placed with a Manchester firm has not so far been reflected in the volume of inquiry on this market for boiler plates and other steel materials, and steel buying in most sections, including special alloy descriptions, is limited in extent. There are very few constructional engineers in the district that are not on short time. Acid and basic quality boiler plates

are both quoted at about £8 10s. per ton, tank plates at £8 17s. 6d., joists at £8 15s., sections at £8 7s. 6d., large-diameter bars at £9 7s. 6d., and small re-rolled kinds at from £6 15s. to £7.

BARROW-IN-FURNESS.

**Hematite.**

There is, if anything, just a slightly better tone in the hematite pig iron market, but at the best business is still very slack. It is comforting to see stocks being reduced at some works, and it will not be long before one or two producers put furnaces into blast. There is still a lack of confidence amongst buyers who are at present disinclined to order more than their immediate requirements demand. Continental and American buyers are not in the market at present, and such shipments as are made to them are small. The iron ore trade is naturally quiet, with so small a number of furnaces in blast in the district. The steel trade also remains quiet, and only the hoop and small section mills are engaged at present. There are few orders in the market, but by the end of the month there may be more activity locally.

**Shipbuilding and Engineering.**

It will be interesting to see if the further orders which the Government proposes to give out on or before the middle of this month will include anything for Barrow. Locally there are hopes that at least a further order will be received. There is a feeling here that Barrow will get a contract.

## SHEFFIELD.

*(From our own Correspondent.)*

**Good Signs.**

SIGNS of a possible improvement in the general trade position are the increased activity and interest in foundry requisites, ferro-alloys, and scrap. Important movements of trade, in either direction, usually start with these materials, and shrewd observers consider that these signs are presaging a general revival. At the moment, however, the position at the Sheffield works shows no change for the better. Business with foreign markets has suffered a further decline, but it is pleasing to notice that sales to the Dominions show an expanding tendency. In heavy and crude steels and general steel lines, the volume of trade which came to Sheffield during October was, on the whole, small, and it will be interesting to see how it compares with the September figures. It is a good thing, in these days, that certain firms have developed several special lines of steel products which are providing fair employment.

**Boom in Steel Strip.**

Much activity prevails among the cold rollers of steel strip, and some are even working at high pressure. Sanderson Brothers and Newbould, Ltd., of Sheffield, report that their cold rolling plant is producing 235 miles of steel strip per month. A big proportion of this material goes to the makers of safety razor blades, and it is calculated that 8¼ million blades per month are made from the firm's strip. Strip has a variety of uses. Large quantities are used for box strapping. The bulk of this trade has been captured from Germany and other foreign countries, and it has developed to such an extent that Sheffield and the Midlands can now meet the needs of the home market in a manner which, as regards quality and price, makes the users independent of foreign material. In addition there is now a considerable export trade in this product.

**Boiler Furnace Features.**

A new type of boiler furnace—the "Brightside B.M.," produced by the Brightside Foundry and Engineering Company, Ltd., which has been referred to previously—has been subjected to further and independent tests, all of which have proved satisfactory. It is claimed that in this type combustion can be manipulated and controlled under every condition of service. It has been designed with much greater attention to details than is usual with such plant, and the fire-bars, for example, are excellent specimens of light casting work. Combustion is said to be so nearly perfect that only at very short periods, day or night, need there be any emission of smoke if properly handled. The company undertakes to demonstrate the furnace, and will give definite guarantees as to fuel consumption.

**The Lighter Trades.**

The majority of the cutlery and plate works are busier now than at any previous time this year, a fact which is due to seasonal reasons, though, at the same time establishments are not nearly as active as in normal times. Extra women workers have been taken on at some of the cutlery and plate factories, but there is still a good deal of unemployment and short-time working in the trade. Retailers are calling for further supplies to meet the Christmas demand, and there is a good business in scissors and safety razor blades.

**Steel Plates for Russia.**

The United Steel Companies, Ltd., of Sheffield, are among the firms which are expected to receive a share of the order for 25,000 tons of steel plates, which has been placed by Arcos, Ltd., with the British Steel Export Association. This steel is urgently required and will be shipped to Russia during November. It is understood that the order was secured despite most severe Continental competition.

**Lack of Railway Orders.**

The general slump of the past year has hit no one more than the specialists in railway buffers and other railway material, and this is reflected in the returns of George Turton, Platts and Co., Ltd., of Sheffield, who have to report a lean year. The loss on the year, they state, is entirely attributable to the greatly decreased volume of orders passing through the company's works. During the past year the building of railway stock for British, Indian, South American and other railways, has been almost at a standstill, while the building of heavy motor vehicles has been on a greatly reduced scale.

**Gas Instead of Petrol.**

A successful trial has been made at Chesterfield with a gas-driven omnibus, and the possibilities of coke-oven gas as a substitute for petrol for propelling public road vehicles will doubtless open up a new field in transport. Under the chassis of an omnibus, loaned by the Chesterfield Corporation, were fitted six high-pressure, light-weight gas cylinders of nickel chromium-molybdenum steel, made by the Chesterfield Tube Company. These were connected in series with stainless steel tubing, and a special type of carburetter was fitted, with a pressure gauge on the right of the driver's seat. The omnibus ran with remarkable smoothness, and there was a complete absence of fumes. A six-cylinder omnibus, it is estimated, will run at least 80 miles without refilling, and with a better quality of gas the mileage would be increased. The cost per 70 miles is computed at 3s. 6d., which is equivalent to petrol at 6d. per gallon.

**Removing an 80-ton Girder.**

The transport of a huge steel girder from the Cammell Laird works at Penistone to the English Steel Corporation's works in Sheffield, necessitated special arrangements by the London and North-Eastern Railway Company. The girder, which weighs 80 tons, is 93ft. long, 11ft. 8½in. high, and 3ft. wide. It had to be accommodated on a special wagon consisting of bogies fitted with special bolsters.

**Eyam Water Scheme.**

The Bakewell Rural Council is seeking sanction to borrow £5250 for works in connection with a water supply for the parish of Eyam. These works are in replacement of a scheme for the provision of a reservoir of 735,000 gallons capacity, which had to be abandoned as a failure after the expenditure of several thousands of pounds.

**Dearne Valley Drainage.**

Local authorities, landowners, and others interested in the drainage of the Dearne Valley area and the removal of the floods menace, at a recent meeting, passed a resolution in favour of the establishment of an internal drainage district for the Dearne and Dove area, which covers 5400 acres and extends from Darton on the west of Barnsley, to Mexborough, a distance of 12 miles, and embraces Wombwell, Cudworth, Darfield, Bolton-on-Dearne, and Wath-on-Dearne. Much of the land is permanently under water. The question of draining this district has been a live one for many years, and there is an impression that something tangible will now result.

**Beverley Traffic Control Signals.**

New traffic control signals of the "electromatic" vehicle-actuated type have been put into action at North Bar, Beverley. The signals are operated when a vehicle passes over a pad sunk into the road, and causes an electric current to pass to the control mechanism. Vehicles will not be held up by the red signal for regular periods, as is the case with the older type of signal, even when, as so often happens, no other vehicle is on the cross road.

## NORTH OF ENGLAND.

*(From our own Correspondent.)*

**The Shipbuilding Industry.**

THE shipbuilding industry on the North-East Coast is passing through very difficult times. On the Tyne there is not a single mercantile vessel on the stocks. There is only one building berth occupied which is at Hawthorn, Leslie's yard, Hebburn, the vessel being the second Portuguese naval sloop which is nearing completion. Official instructions to proceed with the building of the four destroyers which came to the river have not yet been received, but they are expected shortly. Ship-repairers are also finding it impossible to employ all the facilities at their establishments owing to the dearth of orders. Work continues to be spasmodic, and it is almost the rule for a firm to have two or three vessels in hand and then to experience a lean time at least for a few days. At the present there are two or three big repair or conversion contracts in progress, but the majority of vessels which come forward only require voyage or sundry repairs. With trade in such a depressed condition shipowners are not disposed to carry out any repairs other than what they consider are absolutely necessary for the running of their ships. It is not surprising in view of the position that prices are keenly cut in order to secure work. The North-Eastern Marine Engineering Company, Wallsend, has secured a contract for the machinery for the vessel of 3500 tons which is to be built by the Caledon Shipbuilding Company, Dundee, for the Colonial Sugar Refining Company, Ltd.

**The Brighter Side.**

Optimism in the outlook for the shipbuilding industry is not lacking, however. Mr. W. T. Butterwick, naval architect of the Furness Shipbuilding Company, Ltd., Haverton Hill, struck a bright note when he was installed as chairman of the Teesside Branch of the North-East Coast Institution of Engineers and Shipbuilders. He agreed that times were bad, and that even more yards would have to be closed to strengthen the industry; but he held that the very fact that the shipbuilding yards had been comparatively idle so long made it all the more apparent that the demand for ships must be at hand. He mentioned that contracts had been accepted by Tees builders with a total rejection clause, terms which twenty-eight Continental firms had turned down. The results had passed all expectations. His tilt at the Board of Trade survey of North-East industry would be relished by all who resented the slur cast on shipbuilding and the Tees yards in particular. "I am convinced," Mr. Butterwick said, "that we possess on the Tees establishments whose equipment and organisation are not surpassed in this or any other country, as is proved by the wide range of orders secured throughout the depression in face of world-wide competition. The idea, too, that we are a small local industry supplying only local needs is surely so far from the actual facts as to be highly ludicrous—in fact, the major output is on behalf of foreign and Colonial countries. The misleading impression conveyed by the report referred to cannot be too strongly condemned."

**Cleveland Iron Trade.**

There has been a slight expansion in the volume of business in the Cleveland pig iron trade this week, and whilst it is yet too early to judge whether this is a passing phase or the beginning of another buying movement, traders are certainly in a more hopeful frame of mind. An encouraging feature is the renewal of inquiries from overseas customers, who have been absent from this market for a considerable time. The statistical situation is fairly strong. Makers continue to offer cheap lots to firms in Scotland, but terms on which purchases might be made for shipment abroad are not easily obtainable. For home trade prices are unchanged, No. 1 Cleveland foundry iron being 61s., No. 3 G.M.B. 58s. 6d., No. 4 foundry 57s. 6d., and No. 4 57s.

**Hematite Pig Iron.**

The East Coast hematite pig iron trade is without any special new feature. Stocks are still heavy. Quotations are a matter of individual bargaining, and merchants are still underselling makers. No. 1 hematite is quoted at 59s. 6d., and ordinary qualities are on sale at 59s.

**Ironmaking Materials.**

Business in foreign ore is practically at a standstill. Consumers are well stocked and have deliveries to take under running contracts. Best Rubio ore is nominal at 14s. 6d. c.i.f. Tees. The situation as regards blast-furnace coke is unaltered. Good medium qualities remain at 14s. 6d. delivered to North-East Coast works.

**Manufactured Iron and Steel.**

In the finished iron and steel trade inquiries are more numerous, and the outlook is much improved. Departments manufacturing railway requisites have a fair amount of work in hand. There are rumours that orders for over 100,000 tons of material for the new Transandina Railway in Argentina are to be placed in this country, and hope is expressed that a large proportion of the work will be executed in this district. Bridge-building steel is well taken up, and sheet makers are busier. Quotations are unchanged.

**Iron and Steel Exports.**

Returns of the iron and steel exports from the river Tees for the month of October reflect a marked improvement in trade. In the aggregate, the shipments have exceeded by approximately 5000 tons those recorded in September. Scottish purchases of pig iron have been slightly reduced, but the South Wales steel makers have again contracted for supplies of hematite in this district; and foreign shipments have increased by about 1000 tons. Thus the total pig iron shipments for the month have reached 8272 tons, which is the best monthly figure recorded since June last, and compares with 5369 tons in September. Coastwise shipments of manufactured iron and steel have declined by 3000 tons, but overseas exports have increased during the same period by about 5300 tons, and the aggregate for the month is 27,033 tons, compared with 24,693 tons in September.

**The Coal Trade.**

The closing days of October were marked by increased coal and coke shipments from all the North-East Coast ports, and it is to be hoped that November will provide equally encouraging trade. As it is, there has been a good deal of coal sold, and more contracts are pending. The prompt demand for Northumberland large steam coal is well maintained, and the pits are working regularly. Prices are no higher, and in the majority of cases are not above the schedule levels. Best qualities are well booked for prompt, although they are offered freely forward at 13s. 6d. to 13s. 9d. Tyne primes are scarce and well held at 13s. Secondary steams remain steady at 12s. 3d. Steam smalls are not in much demand, although tipping on the ground in Northumberland has about ceased. Ordinary qualities are obtainable at 8s. 6d., with special Tyne sorts at 9s. and special Wears at 11s. Durham gas coals of every quality are readily obtainable for early shipment. Prices, however, show no quotable change. Best kinds are at 14s. 6d., with secondary classes at 13s. to 13s. 6d. There is no apparent movement in coking fuels, and unscreened and smalls are quoted easy at 12s. 6d. to 13s. 3d. A good general demand still prevails for bunker coal, though mainly for first grades, and some additional orders have been secured for Durham prime qualities for shipment to the West Indies. The demand is also supported by a few large cargoes for shipment to coaling centres. Best class Durham bunkers are now quoted firmly at 13s. 9d. to 14s., but secondary qualities are plentiful at 13s. The gas coke trade outlook remains encouraging, and present production is fully taken up. Stocks on the ground, however, are substantial, and demands make little inroad on the total. For fresh output gas coke is particularly scarce and firmly quoted at 18s. 6d. for best qualities, and 23s. for vertical makes. Patent oven coke is steady at 15s. 6d., with super makes at 16s. 6d. Coke nuts are moving freely at 16s. to 18s.

## SCOTLAND.

*(From our own Correspondent.)*

### Shipbuilding.

THE outlook in the shipbuilding industry has not altered to any extent during the past few weeks. The position improved to some extent, the placing of naval orders ensuring a certain amount of work for some yards, but the scarcity of contracts for merchant ships continues, and inquiries are few and far between. So far as the Clyde is concerned, no vessels were launched during October, and no fresh orders, apart from that received by Messrs. Denny, Dumbarton, to build a vessel for the Southern Railway Company, for the Jersey–France service were received. Shipbuilding firms on the East Coast have been a little more fortunate. The Caledon Shipbuilding Company obtained an order for a 3500-ton steamer for Australian owners; the Burntisland Shipbuilding Company a contract for a 3300-ton deadweight collier for London owners; and Henry Robb, Ltd., Leith, an order for a powerful sea-going twin-screw tug for service at Cochin, India.

### Steel.

Makers of heavy steel are affected to a considerable extent by the dearth of orders for shipbuilding material. Demands for structural purposes, too, have not been so plentiful of late. Export demands are also restricted, but some of the works will benefit by the order for plates for Russia. Opinions on the tariff arrangements vary somewhat, but on the whole it is accepted as being more favourable to the trade in general that the position should be stabilised for a period, thus removing a feeling of uncertainty which has prevented to some extent the making of forward arrangements.

### Steel Sheets.

The turnover in black sheets of the lighter gauges has been fully maintained. The closing of the St. Lawrence is nearly due, and liners sailing this week and next will carry a substantial quantity of sheets to Canada. Galvanised sheets are slow to improve, but the tendency is decidedly in that direction.

### Prices of Steel Sheets.

Prices of black and galvanised sheets have been quoted according to the quantity purchased. Black sheets of 24 gauge are now £9 5s. for lots of 10 tons and upwards, and under 10 tons to 4 tons, £9 10s. As the quantity diminishes the price increases, lots under 5 cwt. being at the rate of £12 5s. per ton. These prices are for delivery Glasgow stations or sidings. The export price is £8 5s. per ton f.o.b. Glasgow. The basis price of galvanised sheets 24 g. in lots of 10 tons and upwards is £11 5s. delivered Glasgow stations or sidings, and the export price £10 f.o.b. Glasgow. For galvanised sheets for Canada, India, and Japan British makers are now quoting through the Oriental Steel Company.

### Iron.

Producers of bar iron and re-rolled steel bars have not yet received much benefit from tariffs or from the rise in Continental prices, but it is expected that some improvement will soon be noted. Bar iron is unchanged in price and re-rolled steel bars are quoted £6 10s. home (fixed) and £6 5s. per ton export. Demands for pig iron are mainly satisfied from stock. During the past week 1500 tons of pig iron arrived in this district from Calcutta and 450 tons from England.

### Coal.

The demand for coal for export shows little expansion, but supplies are now very restricted, owing to "quota" regulations, and prices continue to harden. Lanarkshire round fuels are still in fair supply, but Lothians steams are scarce. Fifeshire suffers most under output restrictions, best steam being now very scarce, while some collieries have no Dysart Main to offer for delivery this year. In all districts washed nuts are strong. Aggregate shipments amounted to 255,109 tons, against 255,890 tons in the preceding week, and 253,292 tons in the same week last year.

## WALES AND ADJOINING COUNTIES.

*(From our own Correspondent.)*

### The Coal Trade.

THE tonnage position at the docks last week maintained a rather better level than for some time previously, and it was expected that this fact would be reflected in increased shipments. The figures issued by the G.W.R. Company confirm this expectation. The total for the six docks controlled by the company amounted to 420,435 tons, whereas shipments of coal and coke during the preceding week were 39,000 tons less. Last week's quantity was, in fact, only 17,792 tons less than the total for the corresponding period of last year. Shipments of both steam and anthracite coals contributed to this improvement, and it is interesting to note that up to date exports of coal and coke this year aggregate 17,150,269 tons, or 1,137,190 tons less than for the corresponding period of 1931. It is not possible to be optimistic regarding the returns of shipments for this week being as good as those for last week, as, owing to the severe gale over the week-end, the arrival of tonnage was badly interfered with, though Swansea docks have been well supplied with tonnage. The position at the end of last week was that between Newport and Port Talbot there were forty-one idle tipping appliances, while on Monday this figure was reduced only by seven, making the total thirty-four. The situation at Swansea was much more favourable, as on Saturday last no berths were available and nine steamers were waiting, while on Monday the number of waiting steamers was increased to eleven. There is no doubt that this total would have been substantially increased but for the bad weather interfering with the movement of tonnage.

### Pressure for Anthracite.

Until all the steamers due to load for Canada have been completed, the pressure upon the shipment facilities at Swansea will remain acute, and this condition is likely to prevail until the middle of this month. Reference has been made several times of late to the congestion existing at the Swansea docks, and the conditions prevailing only serve to emphasise the necessity for more elastic arrangements being made in order to cope with emergencies. That the Swansea traders are alive to the importance of this fact is shown by the efforts which were made last week to come to terms with the trimmers and tippers for an adjustment of working hours temporarily. It was stated at a meeting of the members of the Swansea Chamber of Commerce, when a report on the negotiations was presented, that, owing to the congestion, 37,000 tons of shipping had been diverted to other ports in this Channel, which, of course, means a big loss to everybody at Swansea, with the exception of the railway company. The coal trimmers displayed a conciliatory attitude towards the advances of the traders to secure agreement on extra working hours, but, unfortunately, the tippers were not so ready to assist in the matter and declined to come to any decision on their own without consulting the tippers at the other ports in the Channel, which meant postponing the matter, when everyone else recognised the urgency of the question. However, the traders are not letting the matter drop and are making further efforts to continue negotiations so that the necessary machinery can be got ready to meet any future emergency.

### Coal Contract Operations.

Although current business in coal is below what is desired and needed for this market, there is certainly more activity in respect of contract operations. The Lloyd Braziliero has placed an order for about 18,000 tons of bunker coals for shipment to Rio de Janeiro promptly, and the British Admiralty has sent out tender forms to colliery companies in respect of its requirements over 1933. As usual, no particular quantities are specified, but the general estimate is that the quantity required by the Admiralty authorities will only be between 60,000 and 70,000 tons. When one compares this with the quantity which the Admiralty took in pre-war times, viz., about 1,750,000 tons, it will be realised what a disastrous effect the use of oil has had on the steam coal industry of this district. As is well known, there are now no coal-burning vessels in the Navy. It is also understood that the French State Railways are inquiring for prices for about a quarter of a million tons of coal over 1933, but it is rather doubtful whether anything like this quantity will come to South Wales, as there is no doubt that very severe Continental competition will be experienced. So far the Algerian State Railways have not definitely asked for tenders for supplies of patent fuel, but they are expected to be shortly in the market. It is satisfactory to know that the order for 270,000 tons of small coals for the Portuguese State Railways for delivery from now to December, 1933, has been placed with two local firms. Pyman, Watson and Co., Ltd., have secured the order for a total of 199,000 for delivery at Lisbon. The remainder of the contract, viz., about 70,000 tons, for delivery at Oporto, has been placed with Wm. Cory and Son, Ltd.

### Miscellaneous Items.

The report has been current lately that the French Government intends gradually to abolish the quota system in the matter of coal imports, though no news has come to hand of any variation as regards the position as it affects the quantities to be allowed for November. From all accounts the French authorities contemplate achieving their ends in a different way, viz., the regulation of imports by increasing the Customs duties. Furthermore, French shipowners are understood to be endeavouring to obtain the co-operation of the French coal importers in the use of an increased quantity of French-owned tonnage, and it is reported that in the event of their agreeing to pay 1s. per ton extra freight the Government is likely to facilitate the issuing of more licences. The South Wales Executive Board of the Coal-owners' Association met last week to consider the proposed amendments to Part 1 of the Coal Mines Act, which had been prepared by a Committee of the Central Council dealing with the question of an export levy on coal, but the whole matter has been deferred for a month. By the time this report appears in print it is probable that a revision of the minimum pithead prices of house coal will have been made to operate forthwith. The present minimum prices range from 17s. 9d. at the pithead for the lower grade of Monmouthshires to 24s. 6d. for the best grades of large. No change is reported to be contemplated in respect of the best brands, but 1s. per ton advance is expected in the secondary and lower grades, while one coal now graded as second-class is likely to be placed in the first category, which will mean an increase of 5s. per ton in the schedule.

### Organisation in the Iron and Steel Industry.

Delegates representing 19,000 members attended the annual conference of No. 6 Division of the Iron and Steel Trades' Confederation at Swansea on Saturday last and passed a resolution that while noting that the Import Duties Advisory Committee had initiated the setting up of machinery to secure the organisation of the industry, the Conference expressed concern that no indication had been given of the extent to which labour interests and opinions were to be provided for in whatever schemes might be devised. No scheme would be acceptable to the workpeople or secure their co-operation that failed to provide for labour as a fundamental asset in productive enterprises and did not make provisions for its protection and the safeguarding of its interests.

### Engineers' Anniversary.

To commemorate the seventy-fifth anniversary of the founding of the South Wales Institute of Engineers there was an interesting and enjoyable social function at the National Museum of Wales, Cardiff, on Saturday. The President (Mr. D. Farr Davies, F.G.S.) gave a retrospective sketch of the Institute's career, pointing out that it was in 1857 that the then manager of the Dowlais Works (Mr. Wm. Menelaus), one of the most far-seeing engineers of his day, conceived that it would be advantageous if a society of engineers could be formed for the interchange of ideas, and he was unanimously elected the first President. Until 1871, the Institute's headquarters were at Dowlais, and most of its meetings were held at Merthyr Tydvil, but in 1886 rooms were taken at Cardiff, and in 1894 the present buildings at Cardiff were formally opened by the President at that time (Mr. Thomas Forster Brown). The Institute had published forty-eight volumes, which were regarded as the common store-house of the experience of the engineers of South Wales. In 1881 the Institute was incorporated by Royal Charter, mainly through the energy of Mr. James McMurtrie, backed by the influence of Sir Wm. Thomas (afterwards Lord Merthyr) and Mr. Edward Williams, the first secretary.

### Pitwood Workers.

Some time ago the members of the Cardiff and Bristol Channel Pitwood Importers' Association held a number of meetings with representatives of the workmen in order to secure a revision of overtime rates and the removal of certain anomalies. As no agreement was come to, the matter was referred to arbitration, and although the result of this has not at the moment been officially delivered to the Importers' Association, it is understood that the findings are for the most part favourable to the case of the importers.

### Current Business.

The volume of new business for early shipment has recently been very disappointing. It was thought about three weeks ago that the improvement in orders would be sustained, but, unfortunately, such has not been the case. New inquiries for prompt delivery are very restricted, and the tone of the market displays no material change. The demand for large coals is very limited, but on account of their scarcity sized and small coals are firm and difficult to obtain. Coke moves off fairly freely and patent fuel is steady. Pitwood shows no movement as the result of the comparatively poor demand, but prices remain about 21s. 6d. to 22s. 6d.

## PERSONAL AND BUSINESS ANNOUNCEMENTS.

J. BIGWOOD AND SON (1930), Ltd., Wolverhampton, have been appointed representatives of the Republic Steel Corporation, Youngstown, Ohio, for the sale of that Corporation's foreign rights and machinery for the manufacture of electric weld tube and pipe under patents owned and controlled by the Corporation in all countries of the world, excluding the U.S.A. and Canada.

A WORKING arrangement has been arrived at between Newton, Chambers and Co., Ltd., of Thorncliffe Ironworks and Collieries, near Sheffield, and the Wellman Smith Owen Engineering Corporation, Ltd., of Darlaston (Staffs.) and London, to consolidate their mutual interests in the iron and steel industries. In furtherance of this agreement Newton, Chambers and Co., Ltd., have acquired a share interest in the Wellman Smith Owen Engineering Corporation, Ltd., and Mr. W. Newton Drew, Lieut.-Colonel H. W. Woodall, and Sir Samuel Roberts, Bart., have joined the board of the latter company.

## CONTRACTS.

BROOKHIRST SWITCHGEAR, Ltd., Chester, has received an order from the Cardiff Corporation electricity department for nine E.H.T. oil pressure breakers. The contract covers three 250-ampères, three 350-ampère, one 750-ampère, and two 1500-ampère breakers, all 6600 volts.

## CATALOGUES.

TANGYES LTD., Birmingham.—Catalogues on garage equipment and hydraulic machinery.

SCOTT'S SHIPBUILDING AND ENGINEERING COMPANY, Ltd., Greenock.—A brochure giving the firm's history.

J. ROLLAND AND CO., 2, Victoria-street, S.W.1.—Leaflet VI. 63, dealing with the Krupp vertical extrusion press.

BARFORD AND PERKINS, Ltd., Rochester, Kent.—Loose-leaf catalogue on steam, electric, and gas cooking equipment.

SWITCHGEAR AND COWANS, Ltd., Old Trafford, Manchester.—"Construction of the S. and C. Internal Isolation Switchgear."

W. CANNING AND CO., Ltd., Great Hampton-street, Birmingham.—A catalogue of automatic polishing equipment of all types.

STEWARTS AND LLOYDS, Ltd., King's Buildings, Dean Stanley-street, S.W.1.—The firm's standard specification for steel tubes for water, gas, air, sewage, &c.

HOWARD'S WORKS AT BEDFORD.—General satisfaction is felt in the purchase by Mr. Edward Le Bas of the whole of the Britannia Ironworks at Bedford, which for many years were owned by the firm of James and Frederick Howard, Ltd., which went into liquidation some time ago, owing to the depression in agricultural machinery. According to our contemporary, the *Ironmonger*, "circumstances point very strongly to the conclusion that the Bedford purchase is not unconnected with logical developments in the tube and fittings business due to the British tariff," for the Le Bas Tube Company, Ltd., has built up a very large business in fittings made by the Aciéries Georges Fischer, of Switzerland. It is understood that a definite announcement regarding the works will shortly be made, and that probably a new company will be formed. The area of the works is some 20 acres, and there are some 300,000 square feet of roofed shops. We may add that this very important sale was effected by Leopold Farmer and Sons, of London.

# Current Prices for Metals and Fuels.

## IRON ORE.

| | |
|---|---|
| N.W. Coast— | |
| (1) Native | 16/6 to 20/- |
| (1) Spanish | 17/- to 23/6 |
| N.E. Coast— | |
| Native | 18/- to 21/- |
| Foreign (c.i.f.) | 14/6 |

## PIG IRON.

| | Home. £ s. d. | Export. £ s. d. |
|---|---|---|
| (2) Scotland— | | |
| Hematite | 3 7 6 | — |
| No. 1 Foundry | 3 10 0 | — |
| No. 3 Foundry | 3 7 6 | — |
| N.E. Coast— | | |
| Hematite Mixed Nos. | 2 19 0 | 2 19 0 |
| No. 1 | 2 19 6 | 2 19 6 |
| Cleveland— | | |
| No. 1 | 3 1 0 | 3 1 0 |
| Siliceous Iron | 3 1 0 | 3 1 0 |
| No. 3 G.M.B. | 2 18 6 | 2 18 6 |
| No. 4 Foundry | 2 17 6 | 2 17 6 |
| No. 4 Forge | 2 17 0 | 2 17 0 |
| Mottled | 2 16 6 | 2 16 6 |
| White | 2 16 6 | 2 16 6 |
| Midlands— | | |
| (c) Staffs.— | (*Delivered to Station.*) | |
| All-mine (Cold-blast) | — | — |
| North Staffs. Forge | 3 1 0 | — |
| „ „ Foundry | 3 6 0 | — |
| (c) Northampton— | | |
| Foundry No. 3 | 3 2 6 | — |
| Forge | 2 17 6 | — |
| (c) Derbyshire— | | |
| No. 3 Foundry | 3 6 0 | — |
| Forge | 3 1 0 | — |
| (3) Lincolnshire— | | |
| No. 3 Foundry | — | — |
| No. 4 Forge | — | — |
| Basic | — | — |
| (4) N.W. Coast— | | |
| N. Lancs. and Cum.— | | |
| Hematite Mixed Nos. | 3 15 6 (*a*) / 4 0 6 (*b*) / 4 5 6 (*c*) | — |

## MANUFACTURED IRON.

| | Home. £ s. d. | Export. £ s. d. |
|---|---|---|
| Scotland— | | |
| Crown Bars | 9 15 0 | 9 5 0 |
| Best | — | — |
| N.E. Coast— | | |
| Iron Rivets | 11 5 0 | — |
| Common Bars | 9 5 0 | — |
| Best Bars | 10 5 0 | — |
| Double Best Bars | 10 15 0 | — |
| Treble Best Bars | 11 5 0 | — |
| Lancs.— | | |
| Crown Bars | 9 15 0 | — |
| Best Bars | 10 5 0 | — |
| Hoops | 12 0 0 | — |
| S. Yorks.— | | |
| Crown Bars | 9 15 0 | — |
| Best Bars | 10 15 0 | — |
| Hoops | 12 0 0 | — |
| Midlands— | | |
| Crown Bars | 9 0 0 to 9 15 0 | — |
| Marked Bars (Staffs.) | 12 0 0 | — |
| Nut and Bolt Bars | 8 0 0 to 8 10 0 | — |
| Gas Tube Strip | 10 7 6 to 10 10 0 | — |

## STEEL. (*d*)

| | (6) Home. £ s. d. | (7) Export. £ s. d. |
|---|---|---|
| (5) Scotland— | | |
| Boiler Plates (Marine) | 9 0 0 | 8 10 0 |
| „ „ (Land) | — | — |
| Ship Plates, ¾in. and up | 8 15 0 | 7 15 0 |
| Sections | 8 7 6 | 7 7 6 |
| Steel Sheets, ¼in. | 7 15 0 | 7 15 0 |
| Sheets (Gal. Cor. 24 B.G.) | 11 5 0—10 Ton Lots and Upwards Delivered Glasgow Stations. | 10 0 0 |
| „ (Gal. Cor. 24 B.G.) | For Canada | 10 15 0 |

## STEEL (*continued*).

| | Home. £ s. d. | Export. £ s. d. |
|---|---|---|
| N.E. Coast— | | |
| Ship Plates | 8 15 0 | 7 15 0 |
| Angles | 8 7 6 | 7 7 6 |
| Boiler Plates (Marine) | 10 10 0 | — |
| „ „ (Land) | 10 0 0 | — |
| Joists | 8 15 0 | 7 7 6 |
| Heavy Rails | 8 10 0 | — |
| Fish-plates | 12 0 0 | — |
| Channels | 10 5 0 | £9 to £9 5s. |
| Hard Billets | 7 2 6 | — |
| Soft Billets | 5 10 0 | — |
| N.W. Coast— | | |
| Barrow— | | |
| Heavy Rails | 8 5 0 | — |
| Light Rails | 8 10 0 to 8 15 0 | — |
| Billets | 6 10 0 to 9 0 0 | — |
| Manchester— | | |
| Bars (Round) | 9 7 6 | — |
| „ (Small Round) | 6 15 0 to 7 0 0 | — |
| Hoops (Baling) | 10 0 0 | 9 15 0 |
| „ (Soft Steel) | 9 0 0 | 8 15 0 |
| Plates | 8 17 6 to 9 2 6 | — |
| „ (Lancs. Boiler) | 8 10 0 to 8 12 6 | — |
| Sheffield— | | |
| Siemens Acid Billets | 9 2 6 (basis) | — |
| Hard Basic | 8 2 6 and 8 12 6 | — |
| Intermediate Basic | 6 12 6 and 7 2 6 | — |
| Soft Basic | 5 15 0 | — |
| Hoops | 9 10 0 to 9 15 0 | — |
| Soft Wire Rods | 7 10 0 | — |
| Midlands— | | |
| Small Rolled Bars (all British) | 7 0 0 to 7 5 0 | — |
| Small Re-rolled Bars | 6 12 6 to 6 15 0 | — |
| Billets and Sheet Bars | 4 17 6 to 5 7 6 | — |
| Galv. Sheets | 11 5 0 to 12 15 0 | 10 0 0 |
| (2) Staffordshire Hoops | 9 10 0 | — |
| (*d*) Angles | 8 7 6 | — |
| (*d*) Joists | 8 15 0 | — |
| (*d*) Tees | 9 7 6 | — |
| (*d*) Bridge and Tank Plates | 8 17 6 | — |
| Boiler Plates | 8 7 6 to 8 10 0 | — |

## NON-FERROUS METALS.

| | |
|---|---|
| Swansea— | |
| Tin-plates, I.C., 20 by 14 f.o.b. | 15/9 to 16/3 |
| Block Tin (cash) | 152 5 0 |
| „ (three months) | 152 17 6 |
| Copper (cash) | 30 5 0 |
| „ (three months) | 30 8 9 |
| Spanish Lead (cash) | 11 17 6 |
| „ „ (three months) | 12 2 6 |
| Spelter (cash) | 15 1 3 |
| „ (three months) | 15 7 6 |
| Manchester— | |
| Copper, Best Selected Ingots | 34 10 0 |
| „ Electrolytic | 36 0 0 |
| „ Strong Sheets | 65 0 0 |
| „ Tubes (Basis Price), lb. | 0 0 10 |
| Brass Tubes (Basis Price), lb. | 0 0 9 |
| „ Condenser, lb. | 0 0 11½ |
| Lead, English | 13 17 6 |
| „ Foreign | 12 5 0 |
| Spelter | 15 5 0 |
| Aluminium (per ton—raw ingot) | £95 |

## FERRO ALLOYS.

| | Per Ton. | Per Unit. |
|---|---|---|
| Tungsten Metal Powder | 1/10½ per lb. | |
| Ferro Tungsten | 1/7½ per lb. | |
| Ferro Chrome, 4 p.c. to 6 p.c. carbon | £25 15 0 | 8/- |
| „ „ 6 p.c. to 8 p.c. | £24 10 0 | 7/6 |
| „ „ 8 p.c. to 10 p.c. | £22 5 0 | 7/- |
| „ „ Specially Refined | | |
| „ „ Max. 2 p.c. carbon | £36 10 0 | 11/- |
| „ „ „ 1 p.c. carbon | £42 12 0 | 14/- |
| „ „ „ 0·70 p.c. carbon | £44 0 0 | 16/- |
| „ „ „ carbon free | 1/- per lb. | |
| Metallic Chromium | 2/9 per lb. | |
| Ferro Manganese (per ton) | £10 15 0 for home | |
| „ „ „ „ | £9 15 0 for export | |
| „ Silicon, 45 p.c. to 50 p.c. | £13 10 0 scale 5/- per unit | |
| „ „ 75 p.c. | £19 10 0 scale 6/- per unit | |
| „ Vanadium | 12/6 per lb. | |
| „ Molybdenum | 6/3 per lb. | |
| „ Titanium (carbon free) | 9d. per lb. | |
| Nickel (per ton) | £245 0 0 | |
| Ferro Cobalt | 7/9 per lb. | |

## FUELS.

### SCOTLAND.

| | Export. |
|---|---|
| Lanarkshire— | |
| (f.o.b. Glasgow)—Steam | 13/- |
| „ „ Ell | 15/- |
| „ „ Splint | 14/- to 16/- |
| „ „ Trebles | 14/6 to 15/- |
| „ „ Doubles | 12/6 |
| „ „ Singles | 11/- |
| Ayrshire— | |
| (f.o.b. Ports)—Steam | 11/6 |
| „ „ Jewel | 16/6 |
| „ „ Trebles | 14/6 |
| Fifeshire— | |
| (f.o.b. Methil or Burntisland)—Steam | 11/6 to 13/6 |
| Screened Navigation | 16/- to 16/6 |
| Trebles | 17/- to 18/- |
| Doubles | 13/- to 14/- |
| Singles | 11/- |
| Lothians— | |
| (f.o.b. Leith)—Best Steam | 12/- to 12/6 |
| Secondary Steam | 11/- to 11/6 |
| Trebles | 15/- |
| Doubles | 12/- to 13/- |
| Singles | 10/6 to 11/- |

### (8) N.W. Coast— ENGLAND.

| | |
|---|---|
| Steams | 20/- to 21/- |
| Household | 32/6 to 52/6 |
| Coke | 19/- to 22/6 |
| Northumberland— | |
| Best Steams | 13/6 |
| Second Steams | 12/3 to 12/6 |
| Steam Smalls | 8/6 |
| Unscreened | 12/6 to 13/- |
| Household | 27/- to 39/- |
| Durham— | |
| Best Gas | 14/6 |
| Second | 13/3 to 13/6 |
| Household | 25/- to 37/- |
| Foundry Coke | 24/- |

| Sheffield— | Inland. | Export. |
|---|---|---|
| Best Hand-picked Branch | 27/- to 28/- | — |
| South Yorkshire Best | 23/- to 24/- | — |
| South Yorkshire Seconds | 19/- to 21/- | — |
| Derbyshire Best House | 22/- to 23/6 | — |
| Derbyshire Best Brights | 18/- to 20/- | — |
| Screened House Coal | 18/- to 19/- | — |
| Kitchen Coal | 16/6 to 17/6 | — |
| Best Screened Nuts | 17/- to 18/6 | — |
| Small Screened Nuts | 16/- to 16/6 | — |
| Yorkshire Hards | 17/- to 18/- | — |
| Derbyshire Hards | 17/- to 18/- | — |
| Rough Slacks | 8/6 to 9/6 | — |
| Nutty Slacks | 7/- to 8/6 | — |
| Blast-furnace Coke (Inland) | 10/- on rail at ovens | |
| Furnace and Foundry Coke (Export), f.o.b., 14/6 to 15/6 | | |

### (9) SOUTH WALES.

| | |
|---|---|
| Cardiff— | |
| Steam Coals : | |
| Best Smokeless Large | 19/6 to 19/9 |
| Second Smokeless Large | 18/9 to 19/6 |
| Best Dry Large | 19/- to 19/6 |
| Ordinary Dry Large | 17/9 to 18/3 |
| Best Black Vein Large | 18/3 to 18/6 |
| Western Valley Large | 17/9 to 18/- |
| Best Eastern Valley Large | 17/7½ to 17/9 |
| Ordinary Eastern Valley Large | 17/3 to 17/6 |
| Best Steam Smalls | 13/- to 13/6 |
| Ordinary Smalls | 11/- to 13/- |
| Washed Nuts | 19/- to 31/- |
| No. 3 Rhondda Large | 19/6 to 19/9 |
| „ „ Smalls | 15/- to 16/- |
| No. 2 „ Large | 17/- to 17/3 |
| „ „ Through | 15/6 to 16/- |
| „ „ Smalls | 14/- to 14/3 |
| Foundry Coke (Export) | 22/6 to 36/6 |
| Furnace Coke (Export) | 17/- to 18/- |
| Patent Fuel | 20/- |
| Pitwood (ex ship) | 22/- to 22/6 |
| Swansea— | |
| Anthracite Coals : | |
| Best Big Vein Large | 36/- to 38/6 |
| Seconds | 27/- to 34/- |
| Red Vein | 22/- to 26/6 |
| Machine-made Cobbles | 37/6 to 48/6 |
| Nuts | 36/6 to 48/6 |
| Beans | 28/6 to 32/6 |
| Peas | 19/6 to 21/- |
| Breaker Duff | 8/6 to 9/6 |
| Rubbly Culm | 9/9 to 10/6 |
| Steam Coals : | |
| Large | 20/- to 20/6 |
| Seconds | 18/- to 20/- |
| Smalls | 11/6 to 13/- |
| Cargo Through | 16/- to 17/6 |

(1) Delivered. (2) Net Makers' Works. (3) f.o.b. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire. (6) Home Prices—All delivered Glasgow Station. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (*a*) Delivered Glasgow. (*b*) Delivered Sheffield. (*c*) Delivered Birmingham. (*d*) Rebate : Joists (minimum), 22/6 ; Ordinary Ship, Bridge, and Tank Plates and Sections, 15/- if home consumers confine purchases from associated British Steel Makers. (*e*) Delivered Black Country Stations.

# French Engineering Notes.

*(From our own Correspondent in Paris.)*

### The "Normandie."

The launching of the liner "Normandie" from the Penhoët yard at Saint-Nazaire on Saturday last in the presence of the President of the Republic, the Minister of Marine, and a naval detachment was made the occasion of a national demonstration of French achievement in the art of shipbuilding. In the speeches preceding the ceremony Monsieur Fould, president of the Chantiers de Penhoët, gave impressive figures showing the importance of the work undertaken in constructing the liner, which, he declared, would not only add to the prestige of the French mercantile marine, but, contrary to general expectation, would be likely to prove profitable to its owners. The Minister of the Mercantile Marine, Monsieur Léon Meyer, was optimistic about the future of the French shipbuilding industry, now that it had been reorganised, and had faith in its ability to hold its own in the competition for business. Finally, the President of the Republic, Monsieur Lebrun, gave a valediction to the liner, which, he said, would carry the hopes of France across the Atlantic at 30 knots. The launching of this ship of 75,000 gross tonnage and 67,500 tons loaded displacement had to be carried out with exceptional care. The ship had to be brought to a stop within 1400ft., and could only be launched at a precise moment to avoid the swirl of water from the Loire when the tide reached its highest. If bad weather had interfered with the operation it would have had to be postponed until the spring. Fortunately, the launching was carried out with complete success.

### A Powerful Locomotive.

The State Railways are preparing to deal more effectively with the Transatlantic traffic by building a new harbour station at Cherbourg and a new type of locomotive which will reduce considerably the time of the journey between Cherbourg and Paris. The harbour station, covering a considerable area, will be capable of dealing with passengers and luggage from two liners simultaneously. The ground space will be used for luggage and an upper storey for passengers, with waiting rooms and every convenience for obtaining information. The Cherbourg line is one of the most difficult on the French systems, with heavy gradients, and a particularly powerful locomotive had to be built to haul the Transatlantic trains at record speeds. A "Mountain" type is now being completed at the State Railways' Sotteville Works near Rouen. About 50 cubic metres of water will have to be evaporated between Paris and Cherbourg, and the grate has an area of 5 square metres. Stoking is done mechanically by means of a screw conveyor from the tender to the grate, the speed of rotation being adjusted by the fireman. The tender is mounted on roller bearings and the water tank is welded, while the scoop taking water from the troughs between the rails is manipulated by compressed air. The locomotive has three cylinders, and the admission of steam is by Renaud valves. It is said to develop 2800 horse-power. Special attention has been given to streamline design with parabolic form to the fore part of the locomotive. The trials of the locomotive are expected to last about a month, after which it will be placed on public exhibition.

### Coal Imports and Pitwood.

Before the import quotas reduced considerably the coal trade with the Channel and Atlantic ports, British colliers returned from Bordeaux with cargoes of pitwood, which is the most important forestry product of the Landes. As South Wales coalowners derive no advantage from taking French pitwood now that the normal conditions of interchange have been upset, and there is no longer any economy in return freights, they are procuring supplies elsewhere, and the unsatisfactory state of the French pitwood trade has rendered it necessary for the Syndicat des Exportateurs de Bois de Mines to make urgent representations to the Government. Negotiations are now in progress with the British Government with the object of adjusting exchanges of coal and pitwood, and there is some fear amongst French colliery interests that too great a concession will have to be made to British coalowners for the benefit of pitwood suppliers. In any case, there is reason to hope that arrangements will be come to whereby larger quantities of British coal will be imported in return for a resumption of the South Wales demand for pit props.

### Barrage Reservoirs.

The plans for constructing dams across valleys on the upper reaches of the Seine in order to impound a sufficient volume of water for regulating the river and thereby reducing the risk of floods which have proved disastrous in the past have, for the most part, been held up through the failure of the State to contribute its share towards the expense. Nevertheless, two reservoirs are being completed on the small tributaries Crescent and Chalaux, the name of the latter reservoir being Bois-de-Chaumecon. The work is being undertaken without the assistance of the State because a company had obtained a concession to utilise the hydraulic energy of the larger tributary, the Cure, into which the smaller rivers flow, and the Department of the Seine contributed to the cost of constructing the Crescent and Bois-de-Chaumecon dams where the hydro-electric company will install its plants. The Department of the Seine will have control of the 24,000,000 cubic metres of water that will be impounded in the two reservoirs. They must be entirely filled before the summer of each year, and the water will be discharged into the Cure and thence into the Seine during the succeeding four months. It will depend upon the successful operation of the small reservoirs as regulators of the Seine water level whether the Pannessière-Chaumonard, Champaubert-aux-Bois and other big reservoirs will be constructed. The Department of the Seine is anxious to see the whole scheme carried through for the sake of the surplus water that would be available for its own use, but nothing can be done without financial assistance from the State, which has more pressing problems to deal with at the moment.

# British Patent Specifications.

*When an invention is communicated from abroad the name and address of the communicator are printed in italics.*

*When an abridgment is not illustrated the Specification is without drawings.*

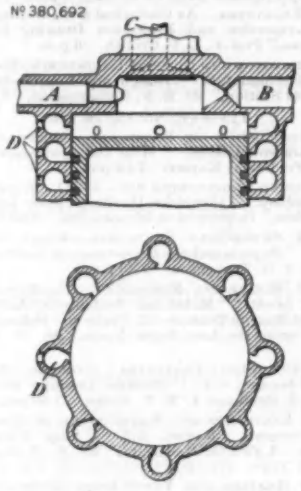
*Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.*

*The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.*

## INTERNAL COMBUSTION ENGINES.

380,692. January 22nd, 1932.—Combustion Chambers, F. Lang, 41, Laimerstrasse, Munich, Germany.

It would appear that the intention of the inventor is to provide fresh air for the combustion of the charge as that combustion progresses. The fuel valve of the engine is shown at A and the primary combustion chamber at B, while the air inlet valve is

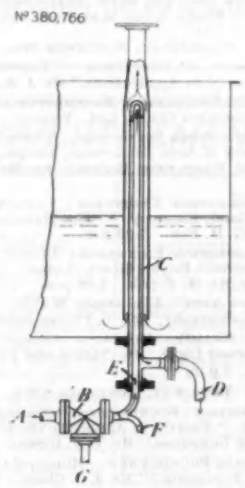



marked C. Down the sides of the cylinder there are cored out pockets D D, which communicate with the interior of the cylinder and may be supplied with compressed air from an exterior source. The ports of these chambers are uncovered in succession and the egress of their contents helps towards the turbulence of the burning mixture.—*September 22nd*, 1932.

## TURBINE MACHINERY.

380,766. June 22nd, 1932.—Oil Heating Devices for Turbines, International General Electric Company, Inc., 120, Broadway, New York, U.S.A.

It is suggested in this specification that steam turbines may be started up more quickly if the lubricating oil is preheated, and that risk of fire, on account of excessive heating, must be

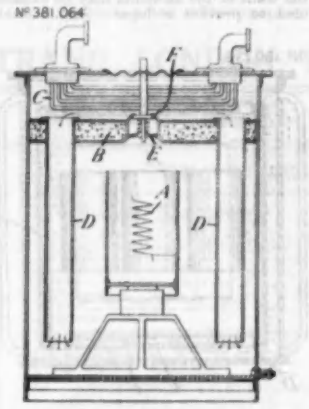



eliminated. The exhaust from the steam-driven oil pump is supplied to the heater at A, and after passing through the three-way valve B goes up through the double-pass tube C to heat the oil in the tank. Surplus steam escapes by the branch D and condensate through the slots E and branch F. In the event of the heating of the oil not being necessary the exhaust steam is passed away by the branch G.—*September 22nd*, 1932.

## LIGHTING AND HEATING.

381,064. October 5th, 1931.—Heat Storage Systems, N. E. North, 86, Strand, London, W.C.2.

This invention relates generally to heating systems and particularly to heat storage systems for use in conjunction with circulating systems wherein the heat derived from a source such as a set of electrical heating elements may be successfully stored and utilised at intervals as and when required. The invention is particularly adapted for the storage of heat from electricity mains during the "off-peak" hours when energy can be obtained at a low price per unit. The heat-storing medium used may be glycerine, ethylene glycol, mannitol, dulcitol, or other polyhydric alcohol, or diphenyl. The container in which the liquid is heated by the electrical element A has a heat insulating partition B. In the upper compartment there is a nest of tubes C, which is part of the circuit to be heated. The two compartments are connected by the tubes D D and by the passage E, which is controlled by the valve F. This valve is operated by a thermostat in the place to be heated. When the temperature falls the valve is opened and the hot

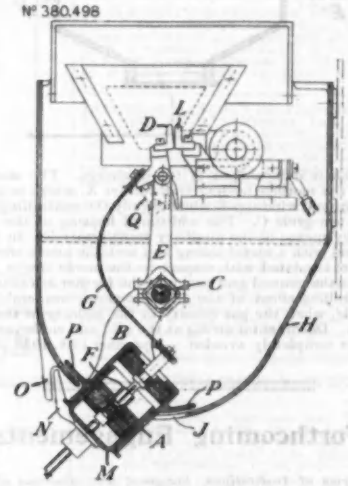



liquid below circulates through the nest of heating tubes.—*September 29th*, 1932.

## MISCELLANEOUS.

380,498. June 17th, 1931.—Electric Couplers, Allen West and Co., Ltd., and William Joseph Paddock, both of Lewes-road, Brighton.

This invention relates to electric couplers and refers to single-pole electric plug couplers for trains. In accordance with the invention, a switch between the line and one element of the coupler is adapted to be opened and closed in response to movement of the element, and mechanical means are provided whereby the other element of the coupler cannot be engaged with or removed from the former element except when that element is at the position for opening the switch. The socket element A of the coupler is carried by an arm B, which is mounted rigidly on, and is insulated from, a rotatable shaft C. The moving contact D of the switch is carried by another arm E, which is mounted rigidly on, and insulated from, the shaft C. The moving contact D is connected to the contact element F within the socket element A by means of a flexible connecting lead G. The whole arrangement is enclosed within a casing H, and the outer end of the socket element A projects through an opening J in the casing. This opening is in the form of a slot which enables the whole rotatable unit, comprising the shaft C, both arms B and E, the socket element A, and the movable switch contact D, to oscillate, and the arrangement is such that when the socket element A is at one end of this slot J, the moving switch contact D is out of engagement with the



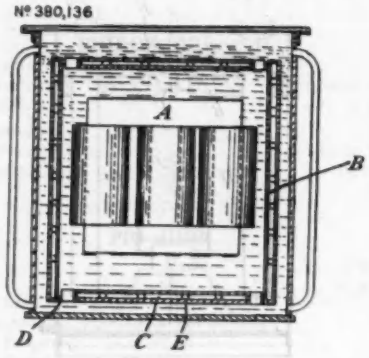

fixed switch contact L, and when the socket element A is at the other end of the slot J, as in the drawing, the moving contact D is in engagement with the fixed contact L. The plug element M of the coupler and the casing H are respectively formed with tongues or lugs N and O, which co-operate in such a way that the plug element M can only be inserted in the socket element A when the latter is at the former end of the slot J and the switch is therefore open. Moreover, when the plug element M has been inserted in the socket element A and the socket has been moved to the other end of the slot J, so that the switch is closed, these tongues O and N co-operate to prevent withdrawal of the plug element M. The portion of the casing in which the slot J is formed is arcuate, with the axis of the shaft C as centre, and the socket element A is provided with a similar arcuate integral flange P surrounding it just within the casing H in such a way as to prevent access through the slot J to the interior of the casing. A latch is preferably provided which retains the socket element at the former end of the slot and prevents it from being returned to the other end until the plug element M is pressed right home. Some form of catch is also preferably provided (which may be suitably interposed between the two tongues or lugs N and O) for preventing the socket element A from being moved from the closing position of the switch inadvertently. The contact D is mounted pivotally on the arm E and is provided with a control spring Q, by which it is adapted to be held against the fixed contact L.—*September 19th*, 1932.

380,136. June 12th, 1931.—Electric Transformers and other Electrical Apparatus, *The British Thomson-Houston Company, Ltd., of Crown House, Aldwych, London, W.C.2.*

Means are described in this specification for reducing the hum of transformers and other apparatus. The transformer comprises a tank adapted to contain a body of liquid, such as oil, in which are submerged the core and windings, indicated at A. The transmitting of the vibration by the liquid is interfered with by surrounding the core unit with a vibration-absorbing element B, supported in any suitable manner in the space between the core unit and the walls of container, and in the preferred form spaced from both, although it may be made as part of the container itself or even as part of the core unit.

The preferred form of such elements consists of a double-walled element open at both ends or having discs C of similar construction. Passages D permit the liquid circulation. The space between the walls of the elements may be exhausted if means are provided to prevent collapse. Any suitable means for

Nº 380,136

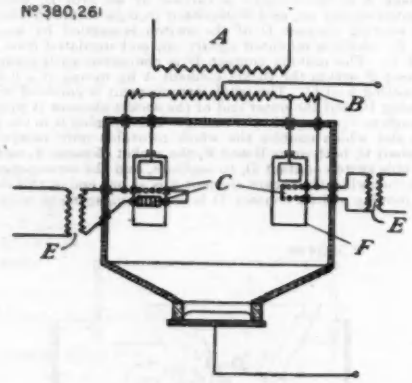



supporting these elements in the tank may be used. Further, in order to ensure the elements against collapse due to pressure when the element is constructed with comparatively thin walls, spacing blocks of suitable non-resilient material, such as cork, hard felt, &c., may be used. Such spacers are indicated at E.—*September 12th*, 1932.

380,261. September 24th, 1931.—Mercury Vapour Rectifiers, Aktiengesellschaft Brown, Boveri et Cie., of Baden, Switzerland.

This invention relates to mercury vapour rectifiers with anodes disposed in sleeves or arms and grids lying in front of the anodes. These grids have the effect of strongly superheating the space within the sleeve or the arm, so that the vapour density in this space is greatly reduced and the occurrence of back firing while the rectifier is in operation is as far as possible prevented. Two or more grids are disposed near each anode in the anode arm or sleeve and all the grids are additionally heated by a source of

Nº 380,261




heat which is independent of the discharge. The anodes are fed from the rectifier feeding transformer A, which is provided with additional windings B which supply the controlling voltage effect to the grids C. The additional heating of the grids is effected by means of the auxiliary transformer E. In the case of rectifiers with a metal casing and metallic anode sleeves the grids C are insulated with respect to the anode sleeve F. The heating of the control grid provides the further advantage that the controlling effect of the grid becomes considerably more favourable, when the gas density in the vicinity of the grid is very low. Detrimental arcing at the grid and consequent back arcing are completely avoided.—*September 15th*, 1932.

## Forthcoming Engagements.

*Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Monday of the week preceding the meetings. In all cases the* TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

### To-day.

British Science Guild.—Burton-on-Trent. Alexandra Pedler Lecture, 1932. "Animals as a National Asset and Responsibility," by Professor F. T. G. Hobday, C.M.G.

Chelsea Polytechnic.—Manresa-road, S.W.3. Opening building extension. Presentation of Diplomas and Certificates. 8 p.m.

Chemical Engineering Group.—Royal Technical College, Glasgow. "Ceramic Insulators: Their Manufacture and Testing," Mr. C. S. Garland. 7.30 p.m.

Inst. of British Foundrymen.—Chamber of Commerce, Birmingham. "Properties of Pig Irons," Mr. J. E. Hurst. 7.30 p.m.

Inst. of British Foundrymen.—Technical College, Preston. "Source and Elimination of Blow-holes, Cracks, and Drawn Holes," Mr. C. H. Kain. 7.30 p.m.

Inst. of Electrical Engineers: N.E. Students.—Armstrong College, Newcastle-upon-Tyne. "Ether and Electrons," Mr. V. H. Grady. 7.15 p.m.

Inst. of Mechanical Engineers.—Storey's-gate, St. James's Park, S.W.1. The Thomas Hawksley Lecture. "Atomic Projectiles and their Applications," by Professor Lord Rutherford, F.R.S. 6 p.m.

Inst. of Metals: Sheffield.—Meeting cancelled.

Inst. of Production Engineers: London Section.—In the Council Room, Society of Motor Manufacturers and Traders, 83, Pall Mall, S.W.1. "Application of Various Steels," by Mr. J. W. Johnson. 7.30 p.m.

Inst. of Sanitary Engineers.—296, Vauxhall Bridge-road, S.W.1. "Guildford Corporation Waterworks Extensions, 1922–31," Mr. P. Griffith. 6 p.m.

Junior Inst. of Engineers.—39, Victoria-street, S.W.1. Informal meeting. 7.30 p.m.

Physical Society.—Imperial College of Science and Technology, S. Kensington, S.W.7. Meeting 5 p.m.

Railway Club.—57, Fetter-lane, Fleet-street, E.C.4. "The Union of Road and Rail," by Mr. Edward Codd. 7.30 p.m.

### Saturday, November 5th.

Inst. of British Foundrymen.—Royal Technical College, Glasgow. "Plaster Patterns in General Foundry Practice," Mr. R. Ballantine. 4 p.m.

Inst. of British Foundrymen.—Technical College, Monks-road, Lincoln. "High-strength Light Alloys," Mr. W. C. Devereux. 7 p.m.

Inst. of British Foundrymen.—College of Technology, Manchester. "Contraction, Distortion, and Camber in Grey Iron Castings," Mr. E. Longden. 4 p.m.

### Monday, November 7th.

Inst. of Electrical Engineers.—Savoy-place, Victoria Embankment, W.C.2. Discussion, "The Present Depression—Is Electricity the Way Out?" Opener, Mr. F. J. Shipley. 7 p.m.

Soc. of Chemical Industry: London Section.—Burlington House, W.1. "Fermentation of Cellulose," by Mr. H. M. Langwell; "Examination of Asphalt Mixtures for Road Pavements," by Mr. Norman H. Taylor. (This paper will be presented by Professor M. G. Clements.) 8 p.m.

Soc. of Engineers.—At Geological Soc., Burlington House, W.1. "Perspective and Projection Drawing for Engineer Draughtsman," Prof. C. L. T. Griffith. 6 p.m.

Wolverhampton and District Engineering Soc.—Victoria Hotel, Wolverhampton. "Design and Construction of Ironbridge Power Station," Mr. E. F. Hetherington. 7.30 p.m.

### Tuesday, November 8th.

Hull Association of Engineers.—Municipal Technical College, Park-street, Hull. "Heat and Acid-resisting Alloys," by Mr. J. Ferdinand Kayser. 7.15 p.m.

Illuminating Engineering Soc.—G.E.C. Research Laboratories, Wembley. "Luminous Discharge Tube Lighting," Mr. C. C. Paterson. Inspection of laboratories. 6.30 p.m.

Inst. of Automobile Engineers.—King's Head Hotel, Coventry. "Repairs and the Importance of the Repair Department," Mr. S. H. Troughton. 7.30 p.m.

Inst. of Electrical Engineers: N. Midland.—Hotel Metropole, Leeds. "Metal-clad Switchgear, Automatic Protection, and Remote Control with Particular Reference to Developments during the Last Seven Years," Mr. H. W. Clothier. 7 p.m.

Inst. of Electrical Engineers: Scottish.—39, Elmbank-crescent, Glasgow, C.2. "Electric Lighting of Buildings," Messrs. A. B. Read and J. W. T. Walsh. 7.30 p.m.

Inst. of Engineers and Shipbuilders in Scotland.—39, Elmbank-crescent, Glasgow, C.2. "Ship Furnishing and Decoration: A Plea for Modernity," Mr. W. A. Gibson Martin. 7.30 p.m.

Inst. of Heating and Ventilating Engineers: Assoc. Members and Graduates.—Borough Polytechnic, S.E.1. "Practical Side of Ventilation," Mr. W. H. Rogers. 7 p.m.

Inst. of Heating and Ventilating Engineers: Assoc. Members and Graduates.—Engineers' Club, Manchester. "Steam Boilers," Mr. W. Atkinson. 7 p.m.

Inst. of Marine Engineers.—The Minories, E.C.3. "Production, Handling, and Marketing of Coal for Marine Purposes," Mr. W. J. Drummond. 6 p.m.

Inst. of Petroleum Technologists.—At Royal Soc. of Arts, John-street, W.C.2. "Mechanism of Lubrication," Messrs. W. F. Parish and L. Cammen. To be read by Dr. F. H. Garner. 5.30 p.m.

Inst. of Production Engineers: Eastern Counties Section.—In the Library, Lecture Hall, Ipswich. "Conflicting Issues in Design and Production," Mr. L. H. Pomeroy. 7.30 p.m.

Inst. of Transport.—Queen's Hotel, Birmingham. "The 'Salter Report' and its Effect on Modern Road Transport," Mr. J. S. Nicholl. 6 p.m.

Staffordshire Iron and Steel Inst.—Girls' High School, Dudley. "High Elastic Limit Mild Steel," Mr. F. G. Martin. 7 p.m.

### Wednesday, November 9th.

Belfast Assocn. of Engineers.—"Pneumatic Conveying System and Some of its Applications," Mr. J. S. Loutit.

Inst. of Civil Engineers: Manchester and District.—Visit, British Insulated Cables, Ltd., Prescot. 1 p.m.

Inst. of Engineering Inspection.—In the Lecture Hall of the Royal Society of Arts, John-street, Adelphi, W.C.2. "The Development of Water-tube Boilers," by Mr. C. H. Davy. 5.30 p.m.

Inst. of Production Engineers: Coventry Section.—King's Head Hotel, Coventry. "The Manufacture of Copper Wire," by Mr. G. H. Fox. 7.30 p.m.

Inst. of Production Engineers: Luton, Bedford, and District Section.—Royal Hotel, Luton. "Modern Heat Treatment," by Mr. H. Toplis. 7.30 p.m.

Royal Soc. of Arts.—John-street, W.C.2. "Developments in Colour Cinematography," Mr. T. Thorne Baker. 8 p.m.

Television Society.—University College, Gower-street, W.C.1. "Polarised Light: Its Nature and Properties," Prof. F. J. Cheshire. 7 p.m.

### Thursday, November 10th.

Inst. of British Foundrymen.—Charing Cross Hotel, London, W.C.2. "Fuel Oil as Applied to the Ferrous and Non-ferrous Foundry Industries," Mr. T. F. Unwin. 8 p.m.

Inst. of British Foundrymen.—Municipal College, Burnley. "Craftsmen or Specialists?" Mr. J. J. Clark. 7.15 p.m.

Inst. of Locomotive Engineers.—Inst. of Mech. Engineers, Storey's-gate, S.W.1. Informal meeting. 6 p.m.

Inst. of Marine Engineers: Junior Section.—The Minories, E.C.3. "Running and Maintenance of Steam Reciprocating Machinery," Mr. R. Jolly. 7 p.m.

Inst. of Mechanical Engineers: Graduates.—Visit to Ford Motor Company, Dagenham.

Inst. of Metals: London Local.—Royal School of Mines, S. Kensington, S.W.7. "Non-ferrous Metals and Alloys in Railway Engineering," Sir Henry Fowler. 8 p.m.

Inst. of Metals: Swansea.—Y.M.C.A., Swansea. "Some Stainless Alloys," Dr. L. B. Pfeil. 6.15 p.m.

Inst. of Structural Engineers.—10, Upper Belgrave-street, S.W.1. "Design of Welded Structures," Mr. C. Helsby. 6.30 p.m.

Inst. of Structural Engineers.—Hotel Metropole, Leeds. Discussion, "Reinforced Concrete *v.* Structural Steel." Openers, Mr. N. B. Liversedge and Mr. A. J. Hodgkinson, 7 p.m.

Manchester Association of Engineers.—Y.M.C.A., Peter-street, Manchester. "The Metallurgical Aspect of Fusion Welding," Dr. J. H. Paterson. 7.30 p.m.

### Friday, November 11th.

Inst. of British Foundrymen.—Cleveland Scientific and Technical Institute, Middlesbrough. "Furnace Linings," Mr. J. F. Hyslop. 7.45 p.m.

Inst. of Electrical Engineers: London Students.—Savoy-place, W.C.2. "Some of the Less Well-known Methods of Electric Propulsion," Mr. R. J. Eldred. 6.15 p.m.

Inst. of Mechanical Engineers.—Storey's-gate, S.W.1. Informal meeting. 7 p.m.

Inst. of Metals: Sheffield.—In Non-ferrous Section of Applied Science Dept. of University, Sheffield. "Practical Digest on Cluster Mills, Four-high Mills, &c., and Trend of Rolling Mill Design," Mr. E. Williams. 7.30 p.m.

Inst. of Transport.—Station Hotel, Newcastle-upon-Tyne. "An Englishman's Impression of the Italian State Railways," Mr. R. C. V. Ash. 7.30 p.m.

Junior Inst. of Engineers.—39, Victoria-street, S.W.1. Annual General Meeting. 7.30 p.m.

Manchester Association of Engineers.—Engineers' Club, Albert-square, Manchester. "The Relation of the Offices to the Shops," by Mr. F. C. Lawrence. 7.15 p.m.

North-East Coast Inst. of Engineers and Shipbuilders.—Bolbec Hall, Newcastle-upon-Tyne. "Fires at Sea," by Mr. E. Leslie Champness. 6 p.m.

### Saturday, November 12th.

Inst. of British Foundrymen.—Technical College, Bradford. Discussion, "Iron Castings *versus* Fabricated Parts," Messrs. A. W. Walker and E. B. Shore. 6.30 p.m.

Inst. of British Foundrymen.—Merchant Venturers' Technical College, Bristol. "Some Methods of Production in a Modern Malleable Ironfoundry," Mr. H. J. Beck. 6.30 p.m.

Inst. of British Foundrymen.—Girls' Welfare Hall, Falkirk Iron Co., Falkirk. "Heat-resisting Cast Iron," Mr. J. W. Donaldson. 6 p.m.

Inst. of Electrical Engineers: London Students.—Visit, Home Office Industrial Museum, Horseferry-road, S.W.1. 3 p.m.

Inst. of Municipal and County Engineers.—Meeting at Deptford Town Hall. 2.15 p.m.

### Monday, November 14th.

Bradford Engineering Society.—Technical College, Bradford. "Charnock Night." "Ropes and Chain Drives," by Dr. H. W. Swift. 7.30 p.m.

Engineers' German Circle (Deutscher Ingenieurzirkel in London).—At the Inst. of Mech. Engineers, Storey's-gate, S.W.1. "Modern Oil Refinery (Neuzeitliche Erdöl-Aufarbeitung)," Dr.-Ing. R. K. Fischer. 6 p.m.

Inst. of Metals: Scottish.—39, Elmbank-crescent, Glasgow. "Production of Hot Brass Pressings," Mr. J. W. N. Beard. 7.30 p.m.

Inst. of Production Engineers: Manchester Section.—In the College of Technology, Manchester. "Management in Manufacturing," by Mr. C. T. Skipper. 7.30 p.m.

Inst. of Transport.—At Inst. of Electrical Engineers, Savoy-place, W.C.2. Annual general meeting. "The Licensing System under the Road Traffic Act, 1930—A Review," Mr. E. S. Herbert. 5.30 p.m.

### Monday to Saturday, November 14th to 19th.

Public Health Exhibition and Congress.—Royal Agricultural Hall, Islington, N. Daily.

### Tuesday, November 15th.

Inst. of Automobile Engineers.—Victoria Hotel, Wolverhampton. "Hydraulic Brakes for Motor Vehicles," Mr. F. G. Parnell. 7.30 p.m.

Inst. of Transport.—At Inst. of Electrical Engineers, Savoy-place, W.C.2. Informal. "Can Railway Methods be Improved?" Mr. D. R. Lamb. 6 p.m.

### Wednesday, November 16th.

Diesel Engine Users Assoc.—Caxton Hall, S.W.1. "Rated Output of Diesel Engines," Mr. W. A. Tookey. 3 p.m.

Electroplaters' and Depositors' Technical Soc.—Northampton Polytechnic, St. John-street, E.C.1. Annual meeting. "Living Organisms in Plating Solutions," Mr. E. A. Ollard. 8.15 p.m.

Inst. of Civil Engineers: Manchester and District.—36, George-street, Manchester. "New Wharf at Irlam (Manchester Ship Canal)," Mr. H. K. Russell. 6 p.m.

Inst. of Locomotive Engineers (London): Birmingham Centre.—Room 178, Queen's Hotel, Birmingham. "Railway Electrification," by Mr. J. W. Beaty. 6.45 p.m.

Inst. of Production Engineers: Birmingham Section.—Chamber of Commerce, Birmingham. Discussion, "What are the Functions of a Planning Department." 7 p.m.

Inst. of Welding Engineers.—Inst. of Mech. Engineers, Storey's-gate, S.W.1. "Cutting Steel with Oxygen Machines," Mr. C. G. Bainbridge. 7.45 p.m.

Newcomen Society.—Caxton Hall, S.W.1. Annual general meeting. "Joshua Field's Diary of 1821," Capt. E. C. Smith. 5.30 p.m. Dinner follows meeting.

North-East Coast Inst. of Engineers and Shipbuilders: Graduates' Section.—Bolbec Hall, Newcastle-upon-Tyne. "Design of Electrical Machinery," by Mr. N. H. Denholm. 7.15 p.m.

Royal Society of Arts.—John-street, Adelphi, London, W.C.2. "The Economic Possibilities of Rice Grass," Mr. James Bryce. 8 p.m.

### Thursday, November 17th.

Inst. of Civil Engineers: Yorkshire.—Hotel Metropole, Leeds. "Main Road Public Lighting," Mr. C. C. Kirby. 7.30 p.m.

Inst. of Electrical Engineers.—Savoy-place, Victoria Embankment, W.C.2. "The Inland Telegraph Service: The Introduction of Modern Machinery and Methods," by Mr. R. P. Smith. 6 p.m.

Inst. of Metals: Birmingham.—University, Birmingham. Discussion, "Heat Treatment without Detrimental Finish." 7 p.m.

Inst. of Production Engineers: Glasgow Section.—In the Inst. of Engineers and Shipbuilders in Scotland, Elmbank-crescent, Glasgow, C.2. "Optical Measurement in Engineering Production," by Mr. A. A. Gigli. 7.45 p.m.

### Friday, November 18th.

Inst. of Automobile Engineers.—Park Lane Hotel, Piccadilly, W.1. Annual dinner. 7 for 7.30 p.m.

Inst. of British Foundrymen: Sheffield and District.—Grand Hotel, Sheffield. "Mammoth Castings for the Cunarder Building on the Clyde," Mr. F. Swift. 7.45 p.m.

Inst. of Mechanical Engineers.—Storey's-gate, S.W.1. "Modern Hydraulic Operation of Machine Tools," Mr. H. C. Town. 6 p.m.

Inst. of Welding Engineers.—Chamber of Commerce, Birmingham. "Eye Protection during Welding Operations," Mr. R. B. Butler. 7 p.m.

Junior Inst. of Engineers.—39, Victoria-street, S.W.1. "The Anderson Rotary Piston Steam Engine," Mr. H. P. H. Anderson. 7.30 p.m.

Overhead Lines Association.—Georgian Restaurant, Harrods Stores, Knightsbridge. Third annual Conversazione. 8 p.m.

### Saturday, November 19th.

Inst. of British Foundrymen.—Loughborough College, Loughborough. "The Uses of Refractory Materials in the Foundry," Dr. J. G. A. Skerl. 6 p.m.

Inst. of Municipal and County Engineers: S. Eastern.—Meeting at Woking. Council Offices, Woking. 11.30 a.m.